September 22, 2016

Towards Horizontal IoT Platform

Standard Architecture, Open Interfaces and Shared Data

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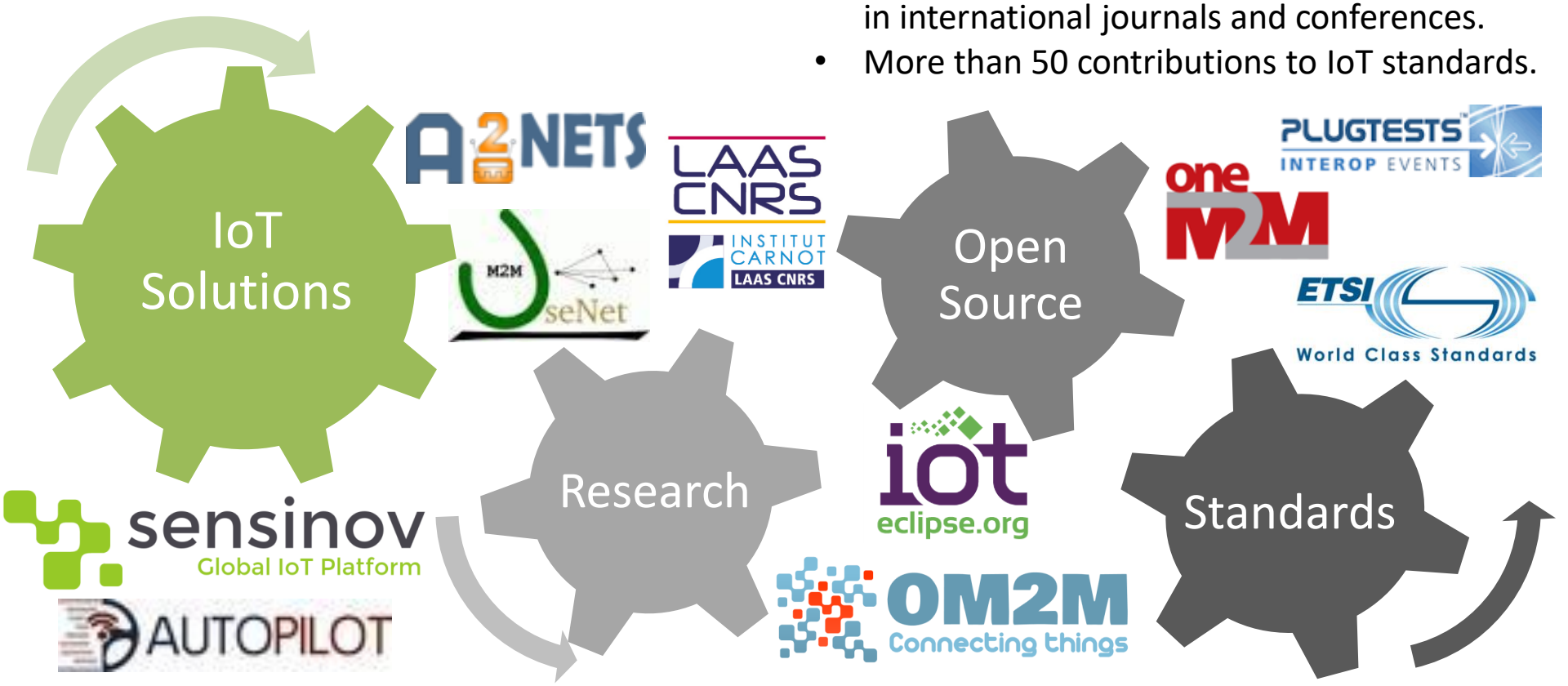
Biography

- R&D engineer at LAAS-CNRS laboratory in Toulouse, France.
- Ph.D in IoT system interoperability
- Founder and CEO of Sensinov startup.
- Vice Chairman of oneM2M Testing Group.
- Co-founder and technical manager of the open source project Eclipse OM2M.
- IoT tutorials in summer schools and universities worldwide including France, Taiwan, and Korea.
- R&D projects at LAAS-CNRS and Sensinov including ITEA2-USENET, ITEA2-A2NETS, H2020-LSP5-AUTOPILOT, ETSI-OSM, and ETSI-SAREF.
- Authored more than 20 refereed publications in international journals and conferences.
- More than 50 contributions to IoT standards.



Outline

- The vision of IoT, stakes and challenges
- oneM2M standard, common architecture for IoT
- Eclipse OM2M, open source oneM2M-based platform
- Sensinov IoT solutions and partnerships

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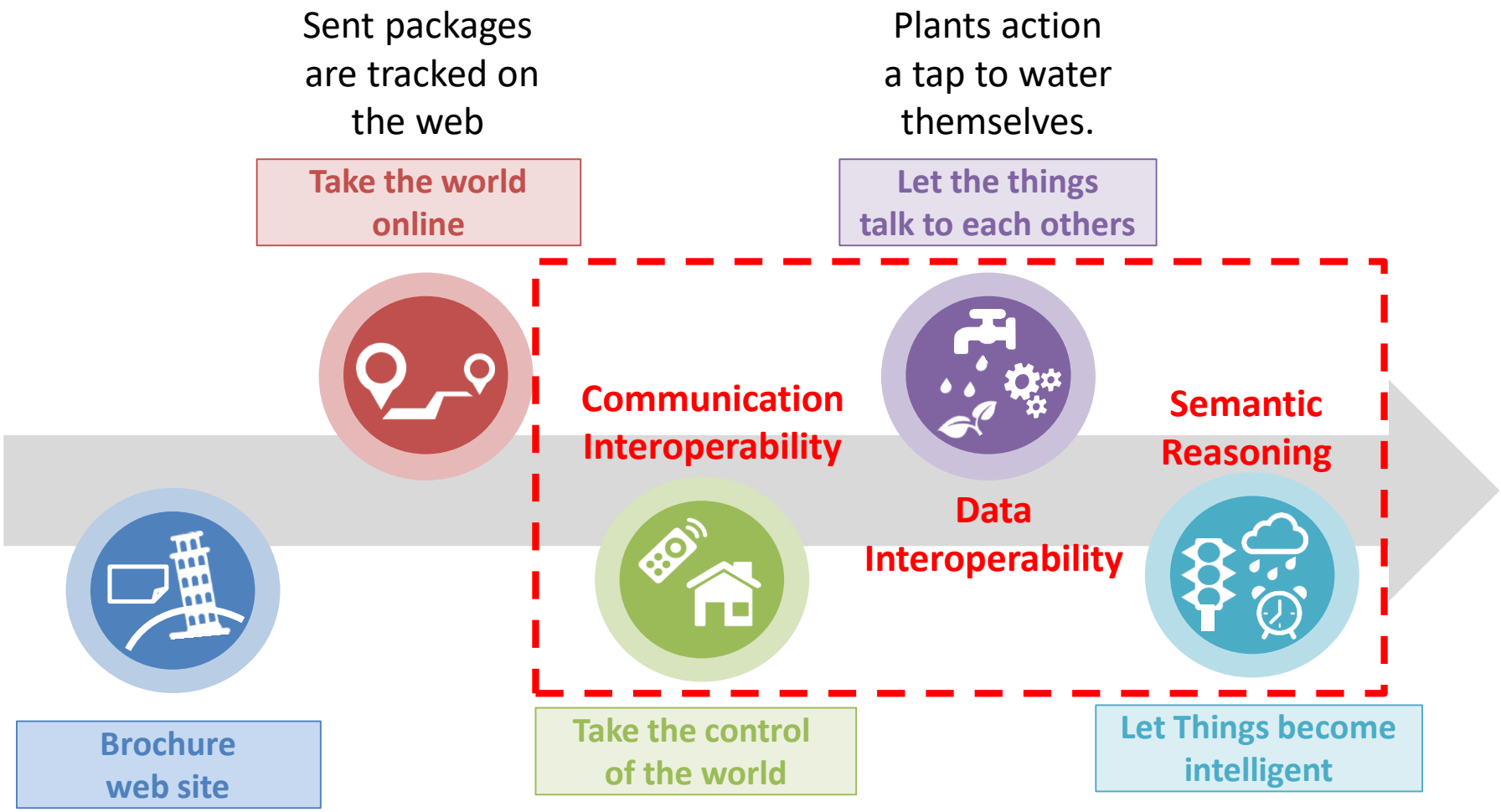
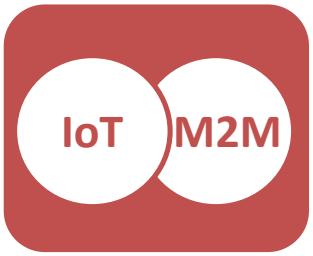
The evolution of IoT



IoT vs M2M

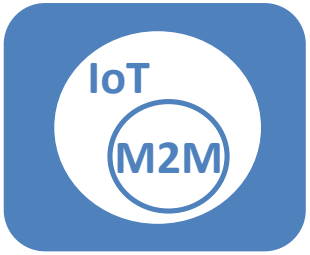
M2M paradigm

The ability of machines to communicate with other devices without human interventions.



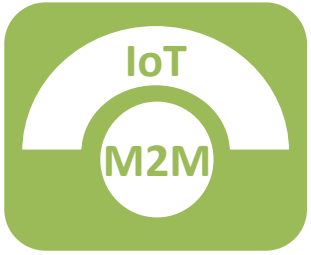
M2M as an industrial environment

- M2M: based on industrial protocols, closed solutions.
- IoT: common usage applications, open solutions for mass.



M2M as a subset of IoT

- M2M: connects devices, electronic sensors, RFID tags.
- IoT: connects general things, animals, peoples.



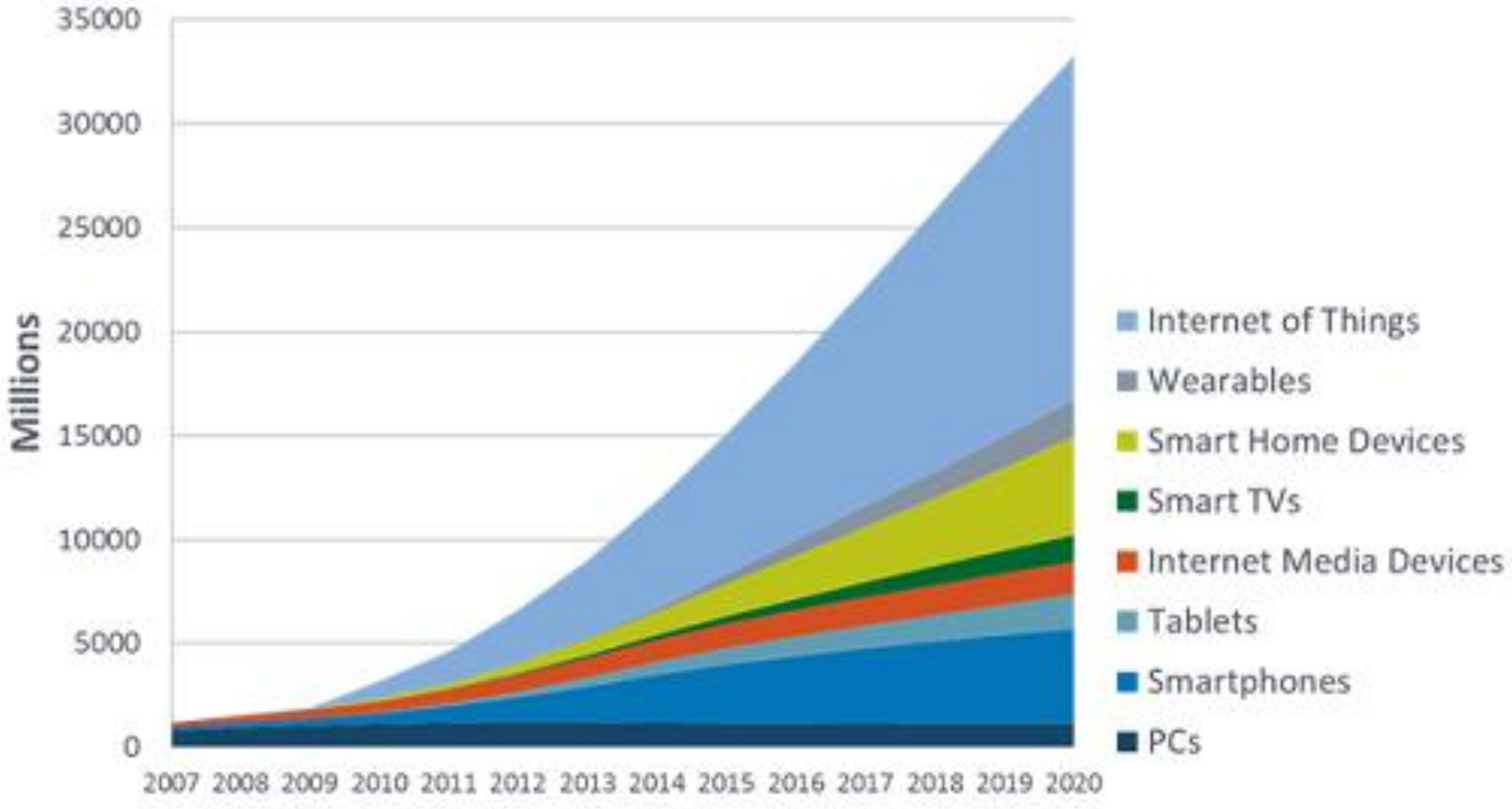
M2M as the kernel of IoT

Adopted definition

- M2M: plumbing of IoT, required connectivity for things.
- IoT: depends on M2M, not possible without it.

Global Internet device installed Base Forecast

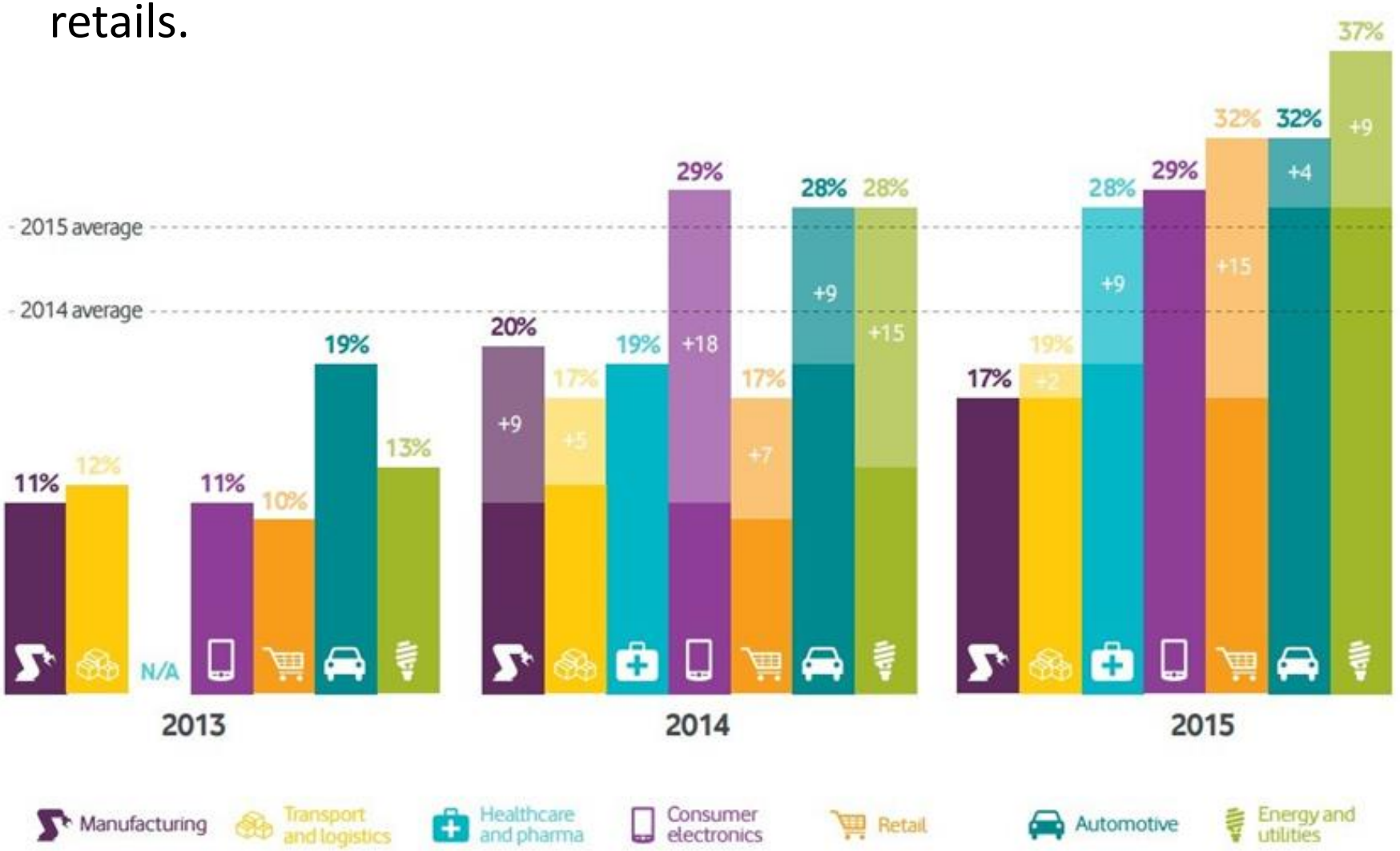
- 33 Billion Internet Devices By 2020: Four Connected Devices For Every Person In World.



Source: Strategy Analytics, October 2014

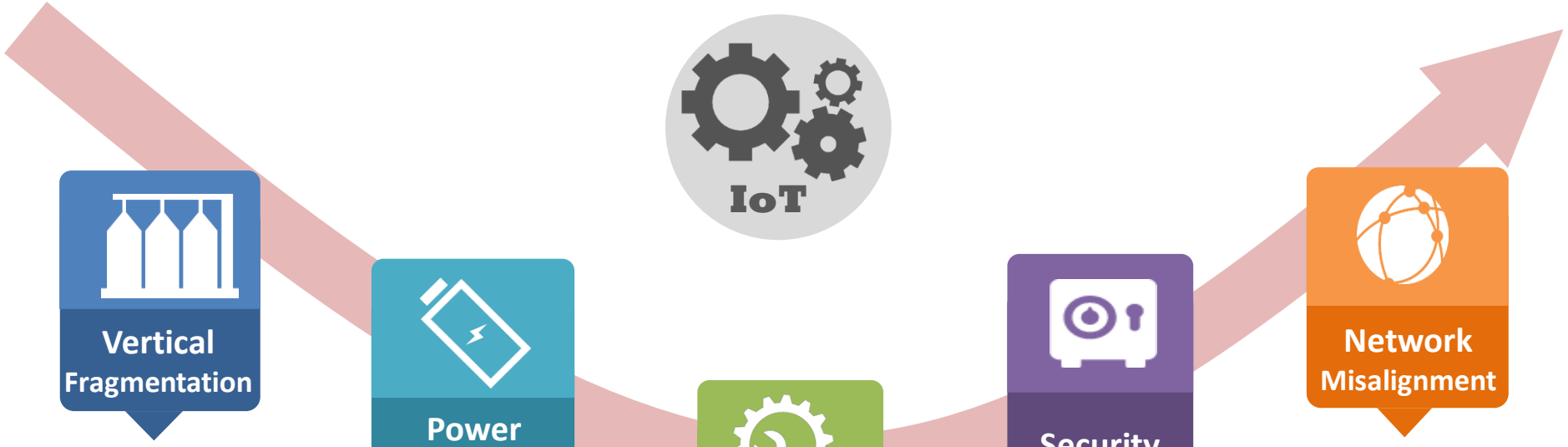
Adoption of IoT by industry

- Energy and utilities leading closely followed by automotive and retails.



Source: The M2M adoption Barometer 2014, Vodafone

IoT main challenges



vendor-specific solutions, no interoperability, semantic gap.

Inefficient battery life-cycles, lack of clean energy.

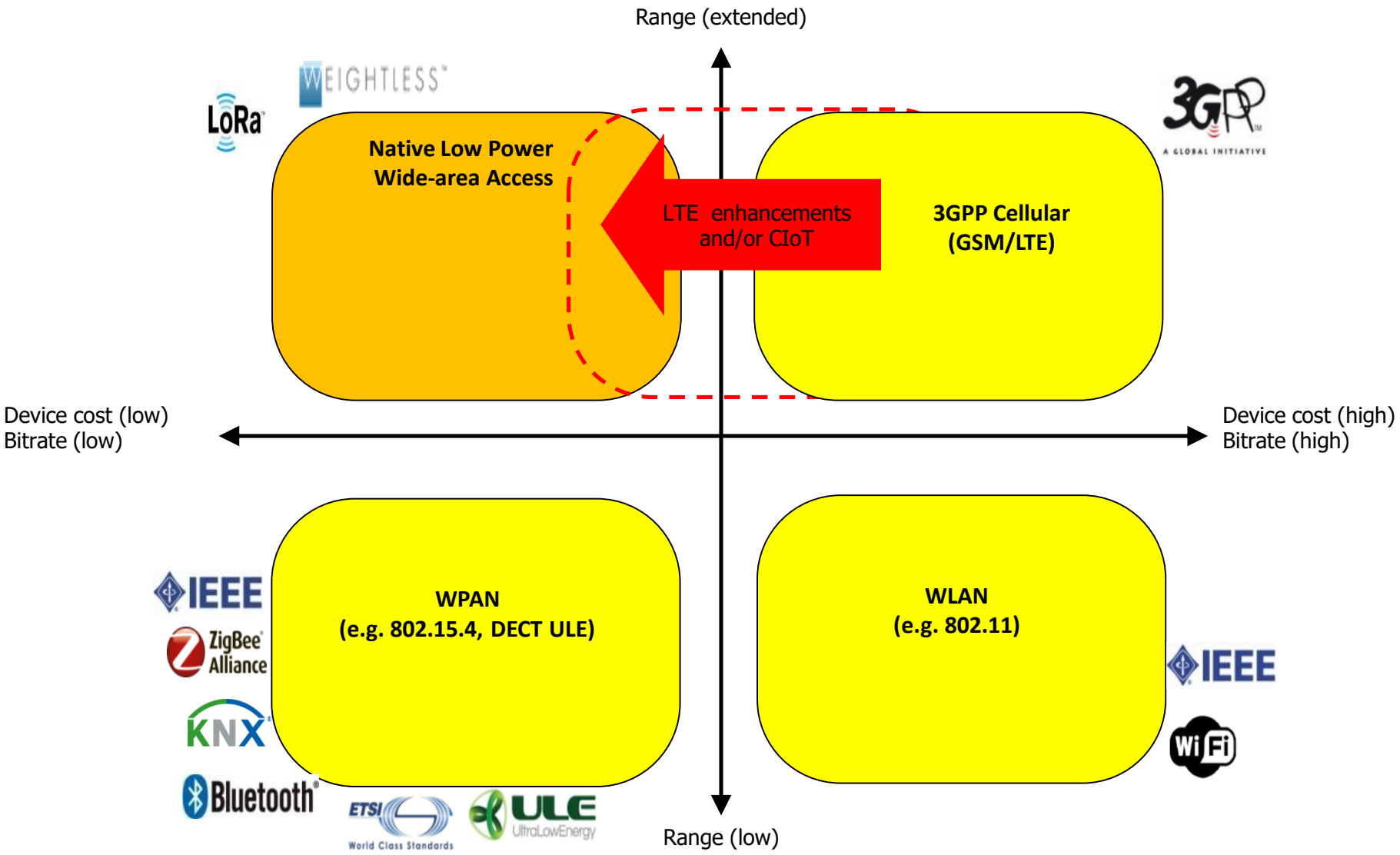
Large number of devices, Unmanageable, high costs

Weakness in M2M devices, privacy, fraud, cyber attacks.

Devices behavior differs from humans: collapse of internet infra.

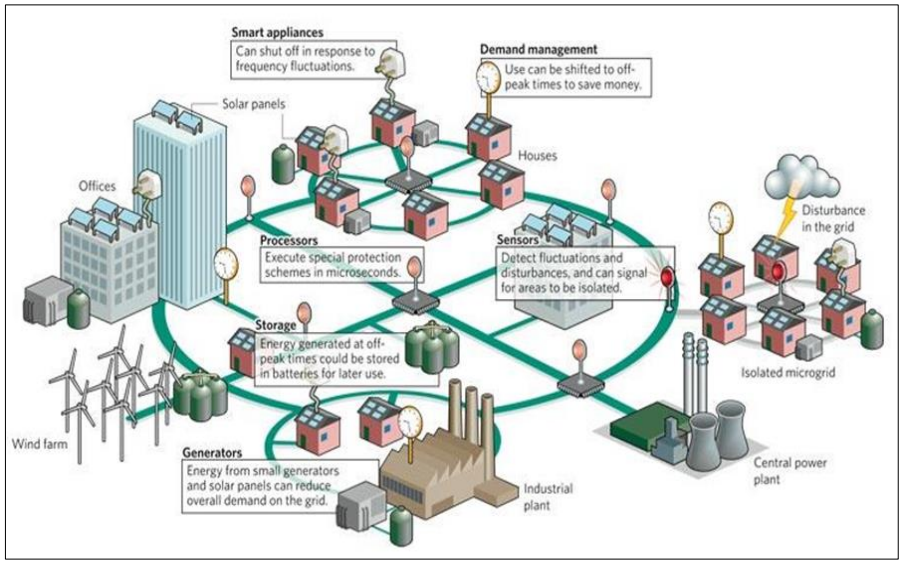
*M2M Communications A Systems Approach - 2012 (book)

IoT connectivity

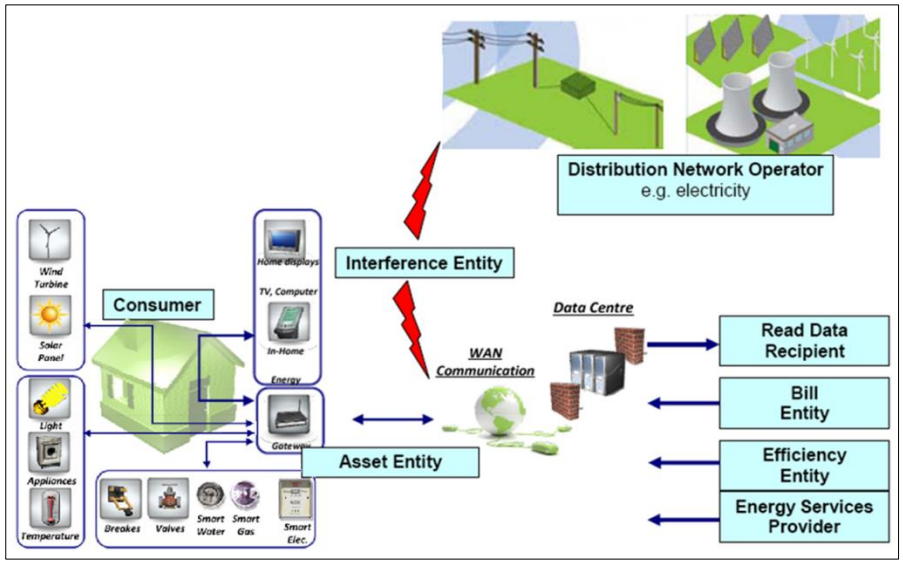


Source AIOTI and ALU

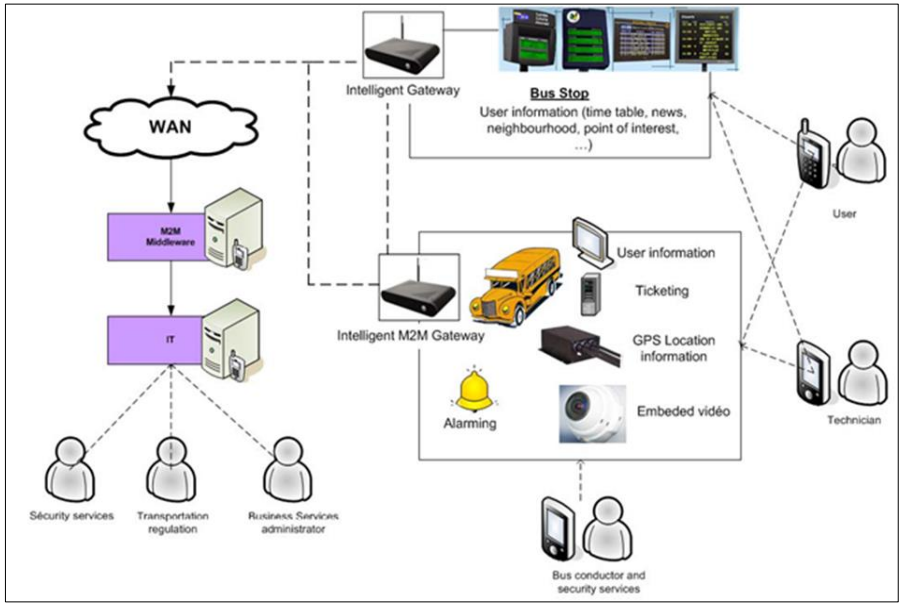
IoT vertical domains



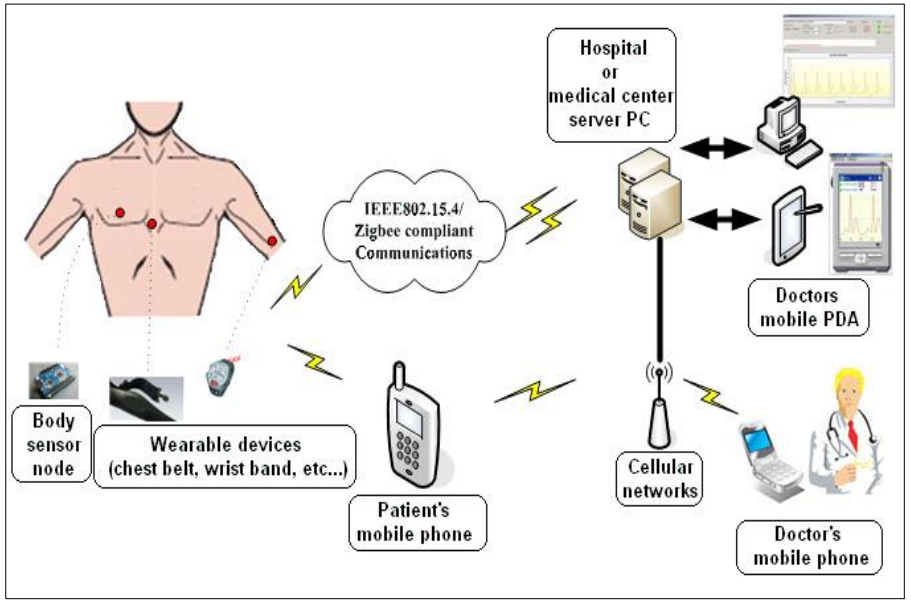
M2M smart grid architecture



M2M smart metering architecture

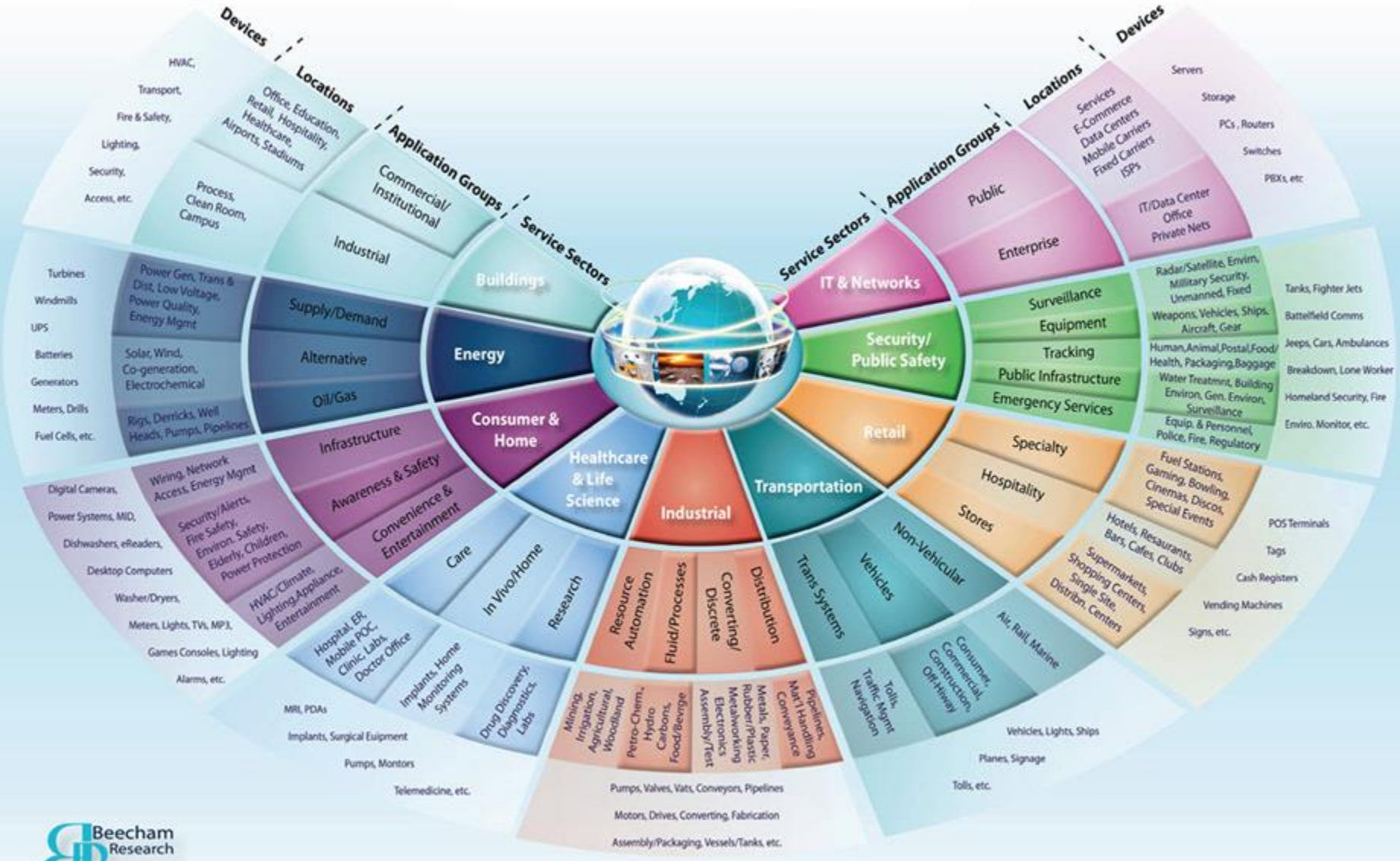


M2M public transport architecture



M2M E-health architecture

M2M world of connected services



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Outline

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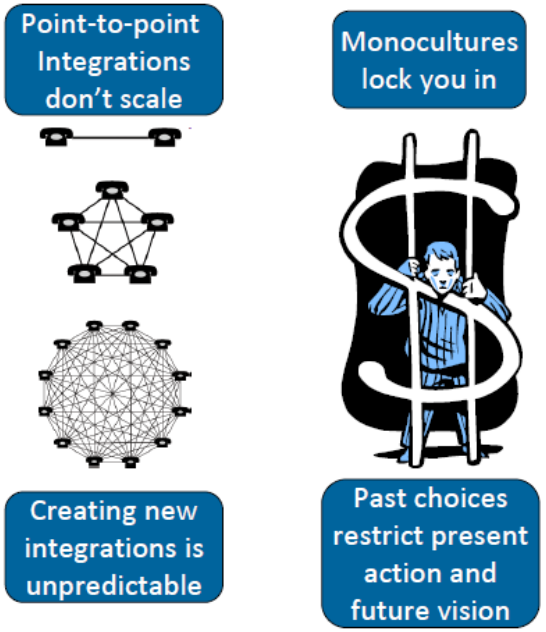
IoT market fragmentation

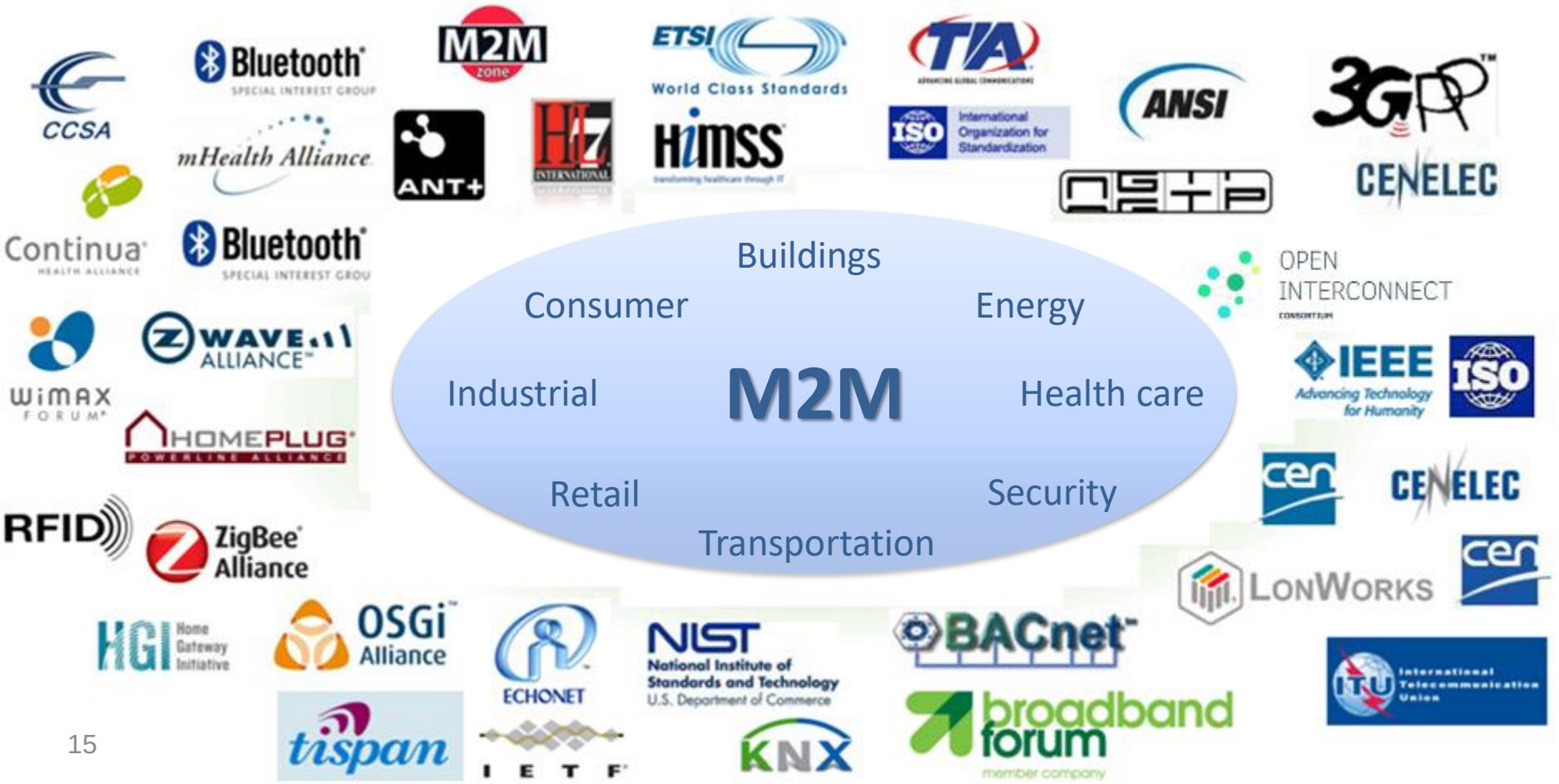


Source: CRYSTAL project/Philips

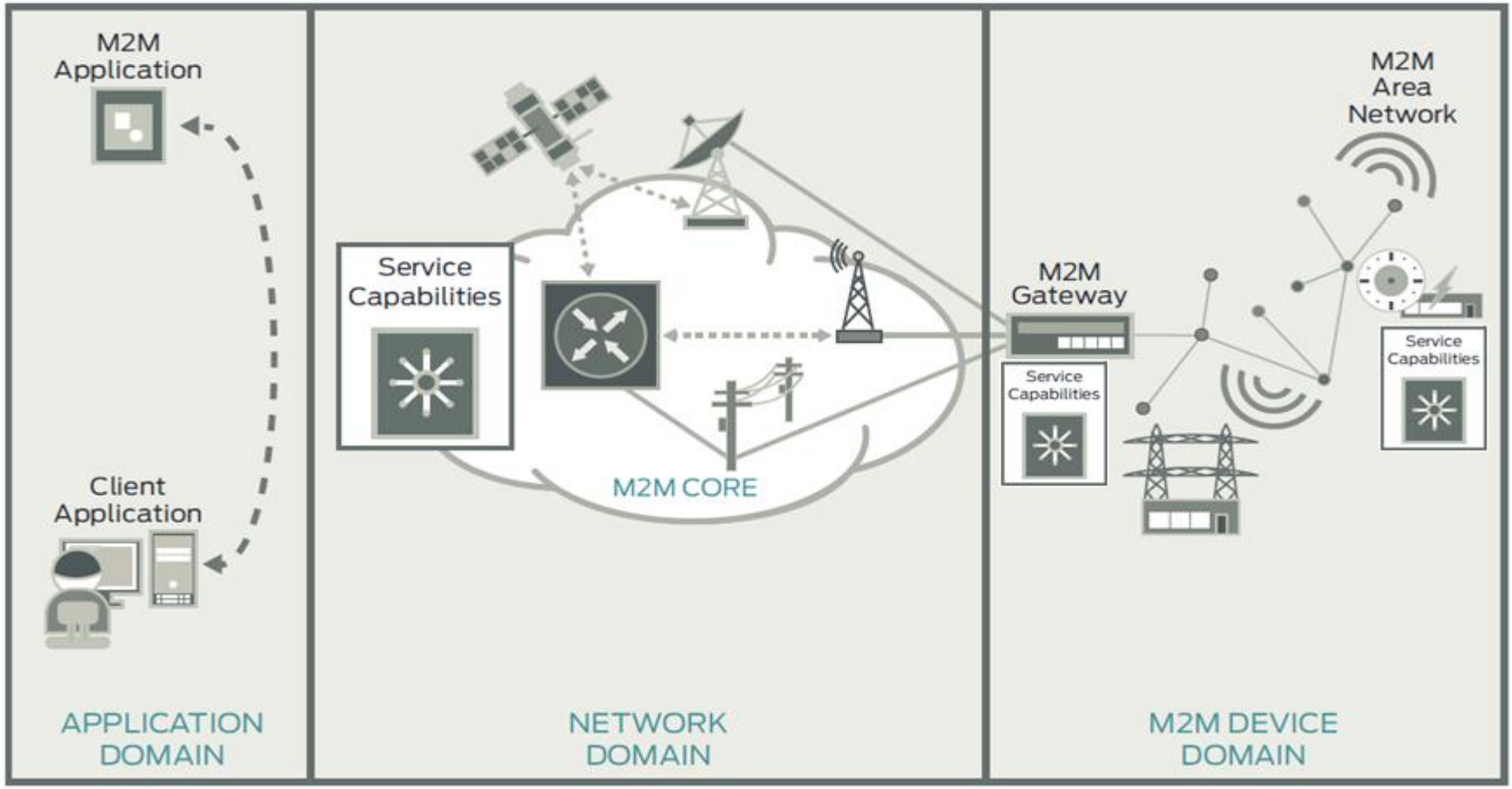
- The current marketplace is extremely fragmented, which has increased the R&D cost in each specific domain.
- Current M2M silo model is not an efficient way to communicate, it is a barrier to further development.
- Many vertical M2M solutions have been designed independently and separately for different applications, which impedes large-scale M2M deployment.

Standards landscape for IoT

- 143 organizations around the world are involved in M2M standardization according to the Global Standards Collaboration M2MTask Force.



IoT high level architecture

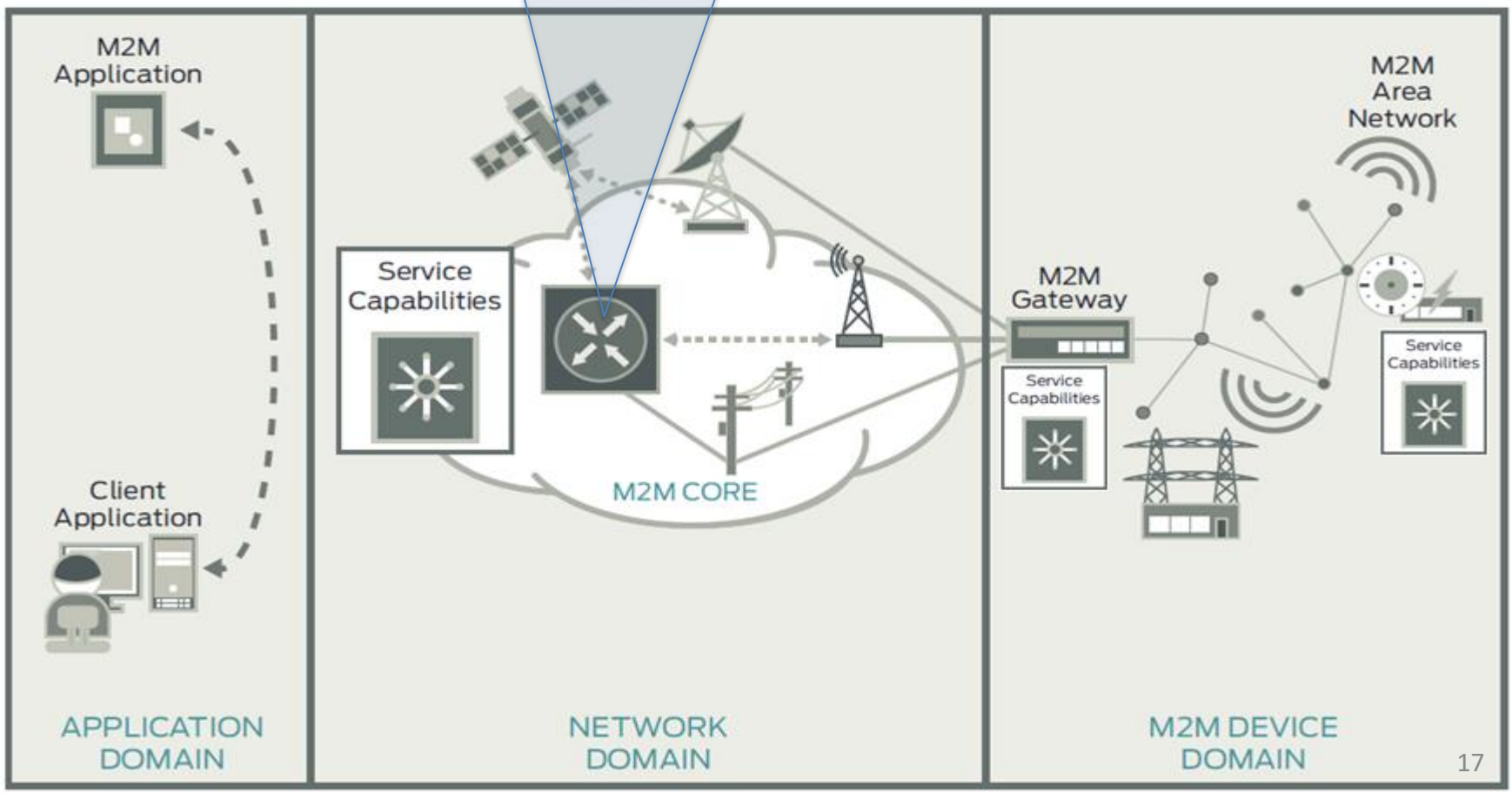


http://www.etsi.org/technologies-clusters/technologies/m2m

Standards for Wide Area Networks

Standards for Wide Area Networks (3GPP, fixed NW, WiMax…):

Target: protect networks against negative effects of M2M traffic (many devices, non-human traffic …)



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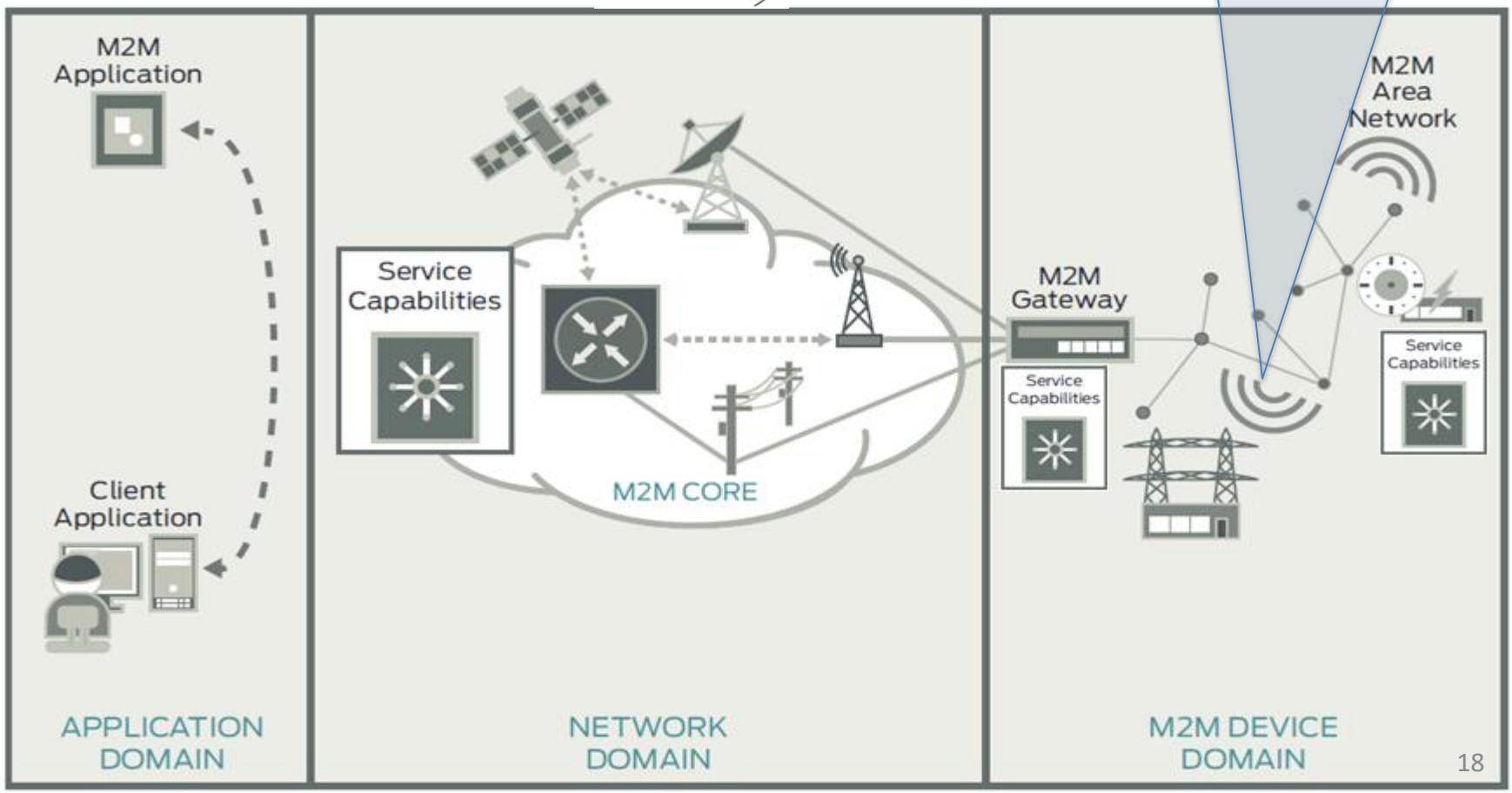
Standards for M2M Area Networks

Standards for Local Area Networks (ZigBee, BLE, Enocean, PLC, etc.)
Target: foster use of LAN technology by supporting diverse ecosystem of service providers and device manufacturers.

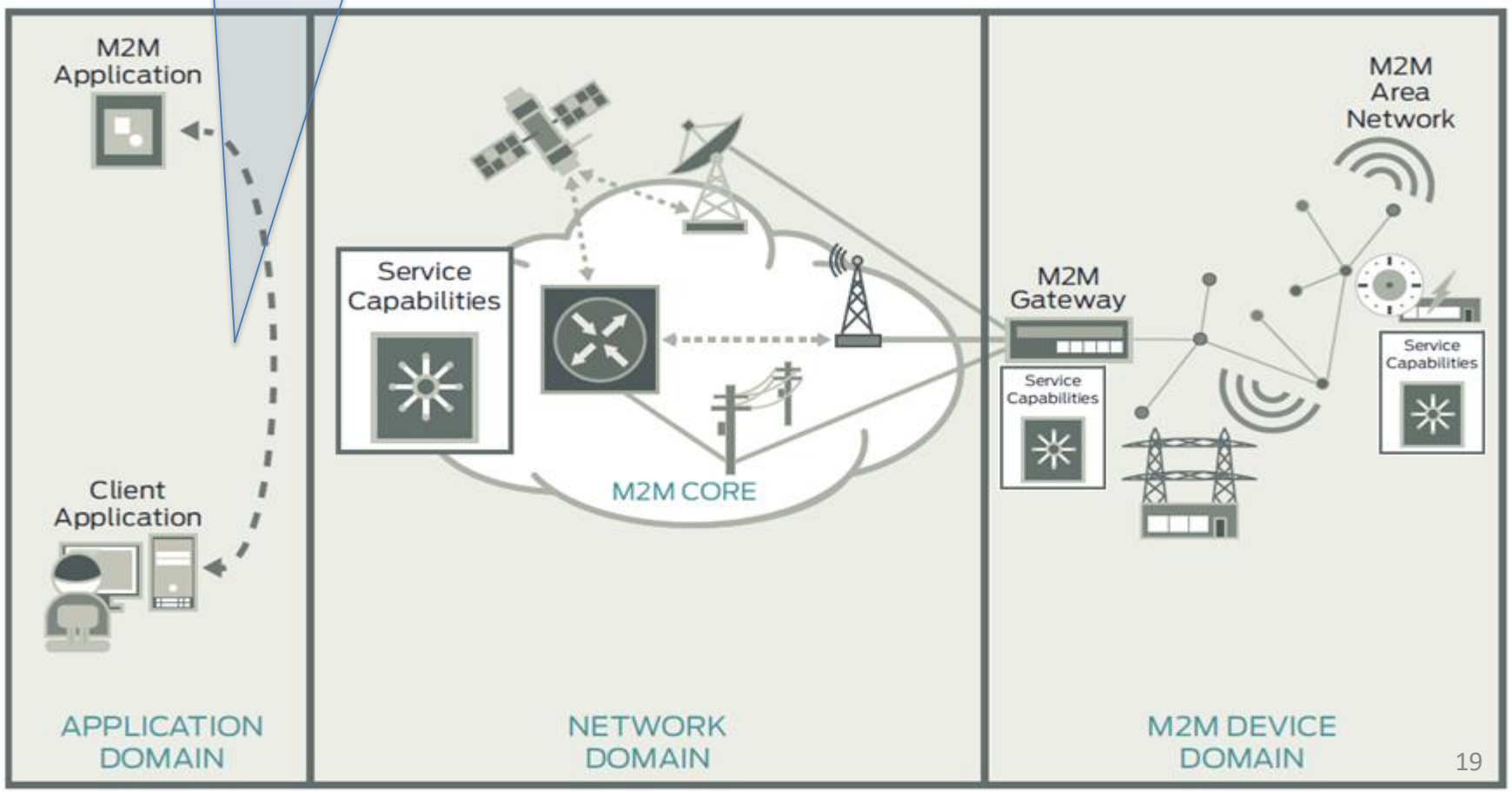


http://www.etsi.org/technologies-clusters/technologies/m2m

Standards for vertical industries

Standards for vertical Industries applications

Target: enable interoperable, cost-efficient Solutions.



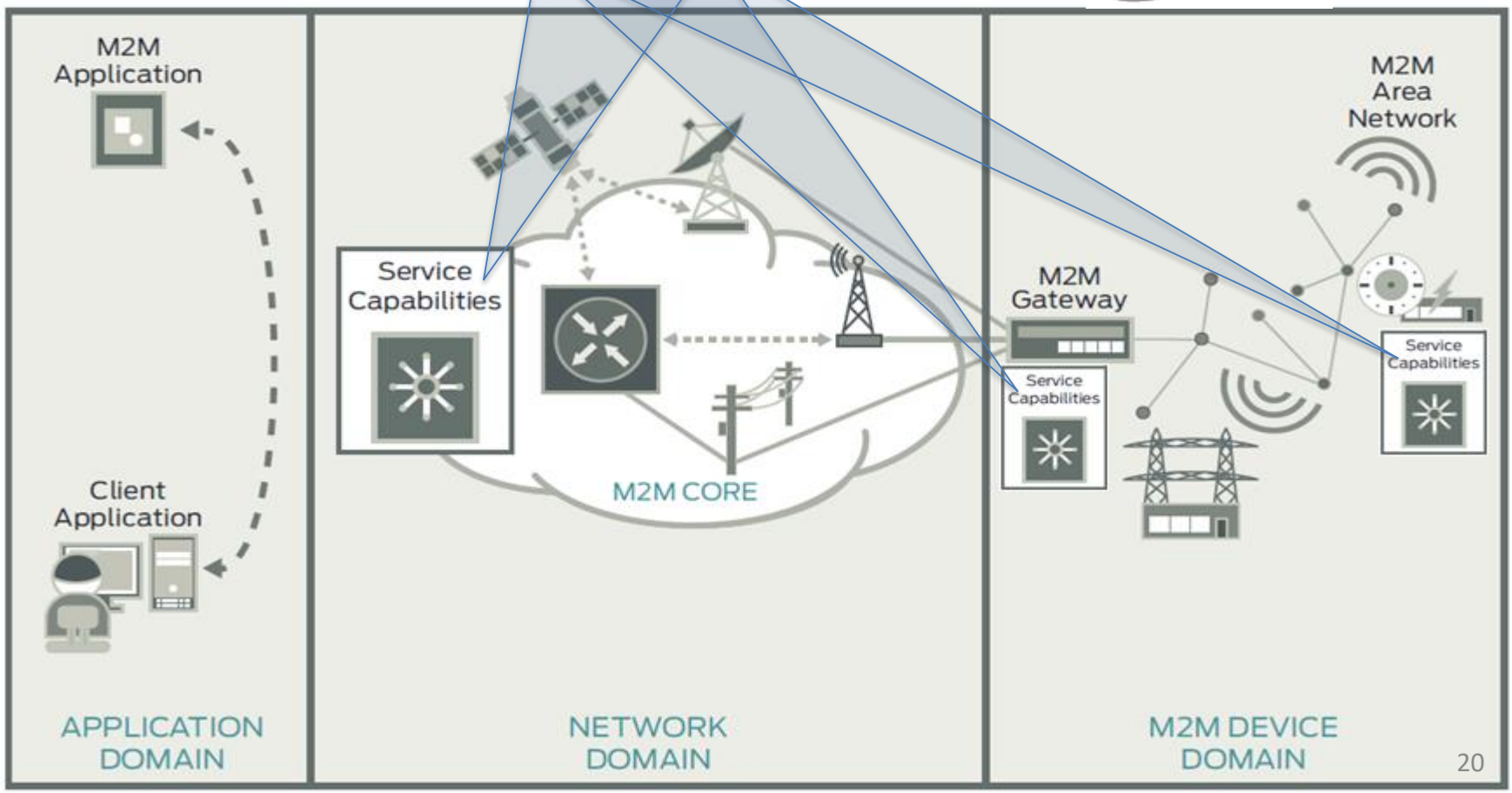
http://www.etsi.org/technologies-clusters/technologies/m2m

Standards for M2M service capabilities

Standards for M2M Service capabilities:

Target: end-to end enablement across servers, gateways, and devices.

Standardized service interfaces.



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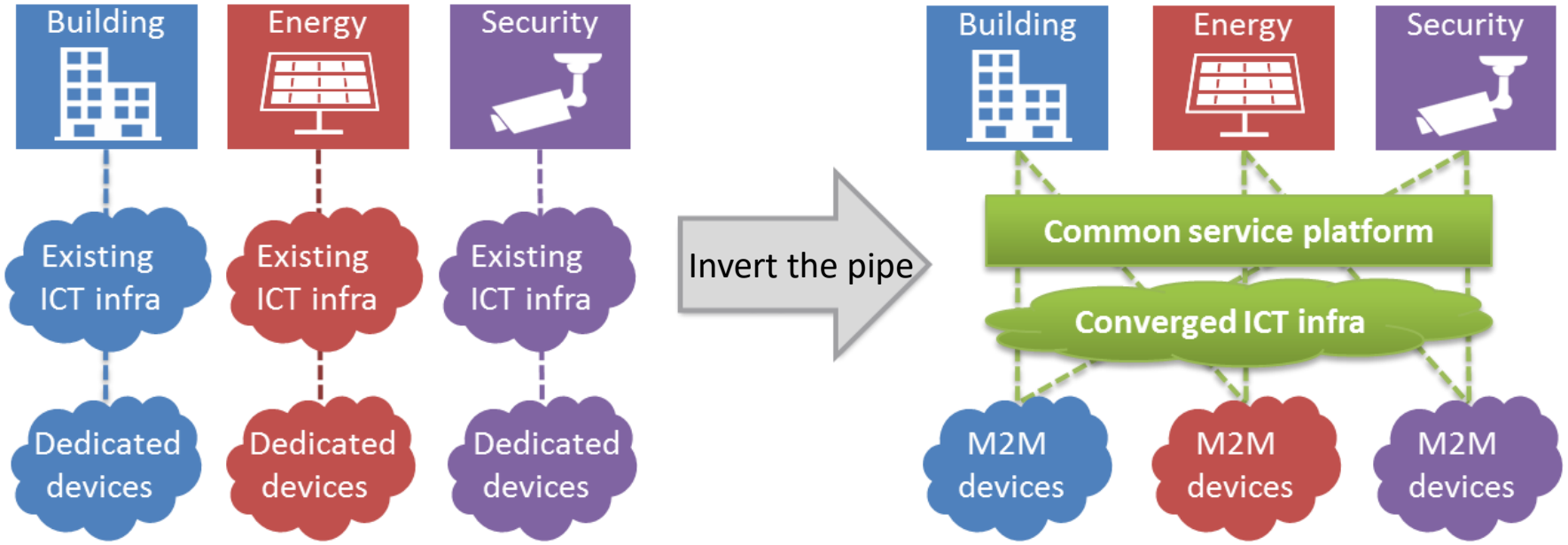
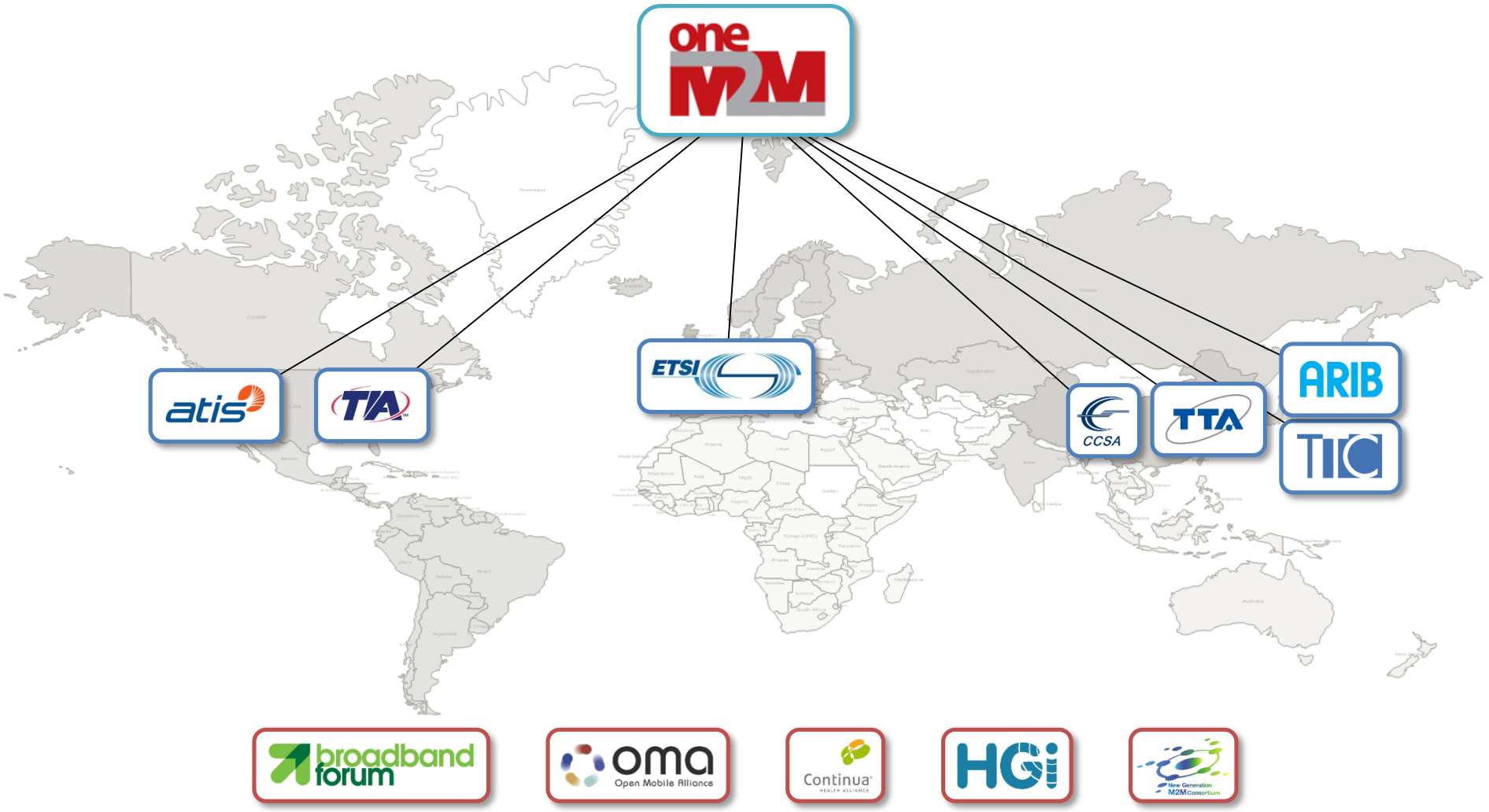
IoT cross-domain interoperability



- Highly fragmented market with small vendor-specific applications.
- Reinventing the wheel: Same services developed again and again.
- Each silo contains its own technologies without interop.

- End-to-end platform: common service capabilities layer.
- Interoperability at the level of communications and data.
- Seamless interaction between heterogeneous applications and devices.

oneM2M: The Partnership Project



www.oneM2M.org

All document are publically available

Over 200 member organizations in oneM2M

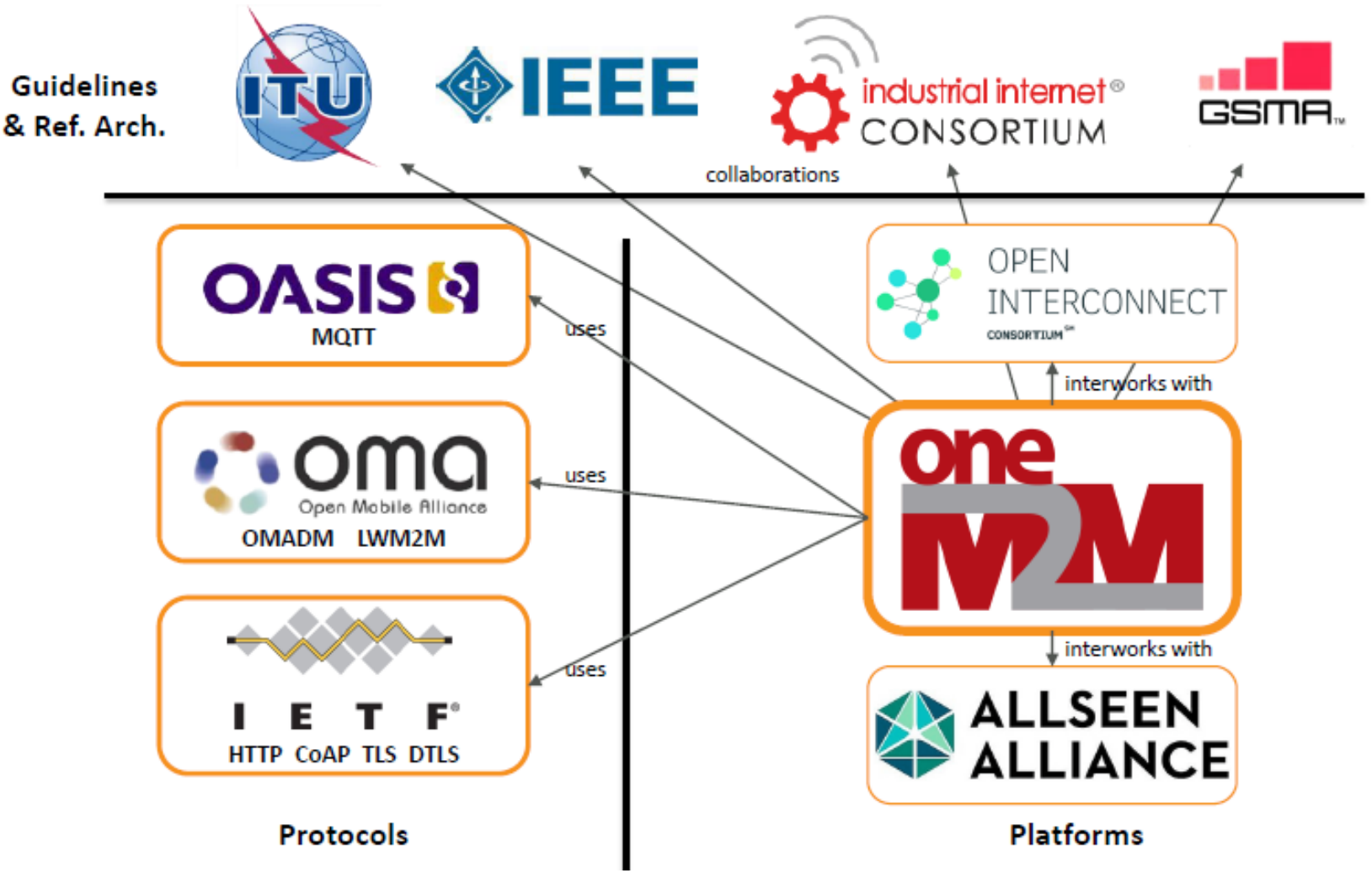
Open source implementations

Commercial Implementations and Demos

Interoperability events

1st: 14-16 Sep 2015, Nice France
2nd: 10-13 May 2016, Seoul Korea
3rd: (Coming soon) 29 Nov – 02 Dec 2016 , Kobe Japan

oneM2M liaisons



Purpose, Work & Deliverables

Purpose

To specify and promote an

M2M Common Service Layer

Work

Six physical 1-week meetings per year

About 5 conference calls per week between the meetings

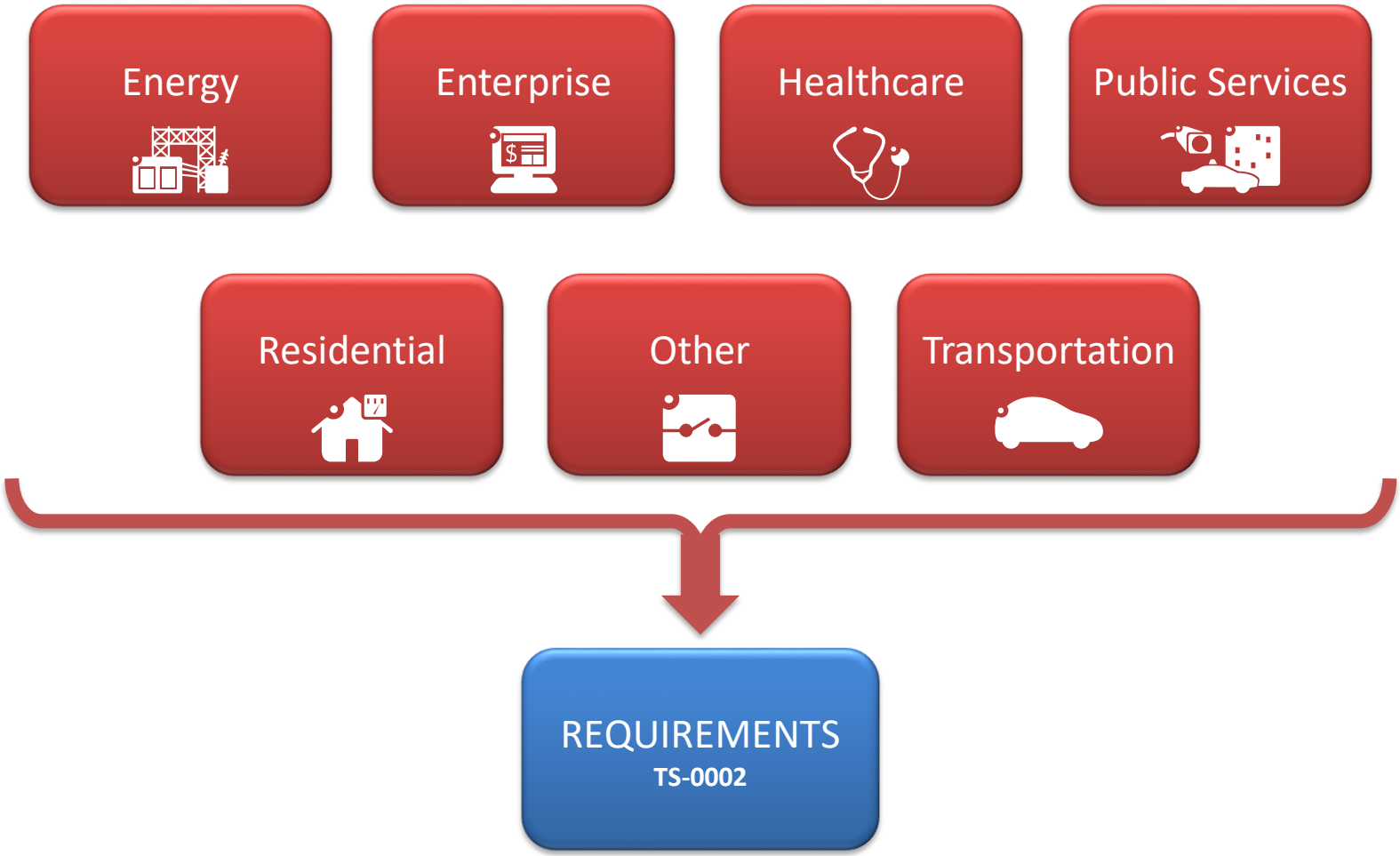
200+ documents produced and discussed at each meeting

3800 docs in 2013 4200 docs in 2014

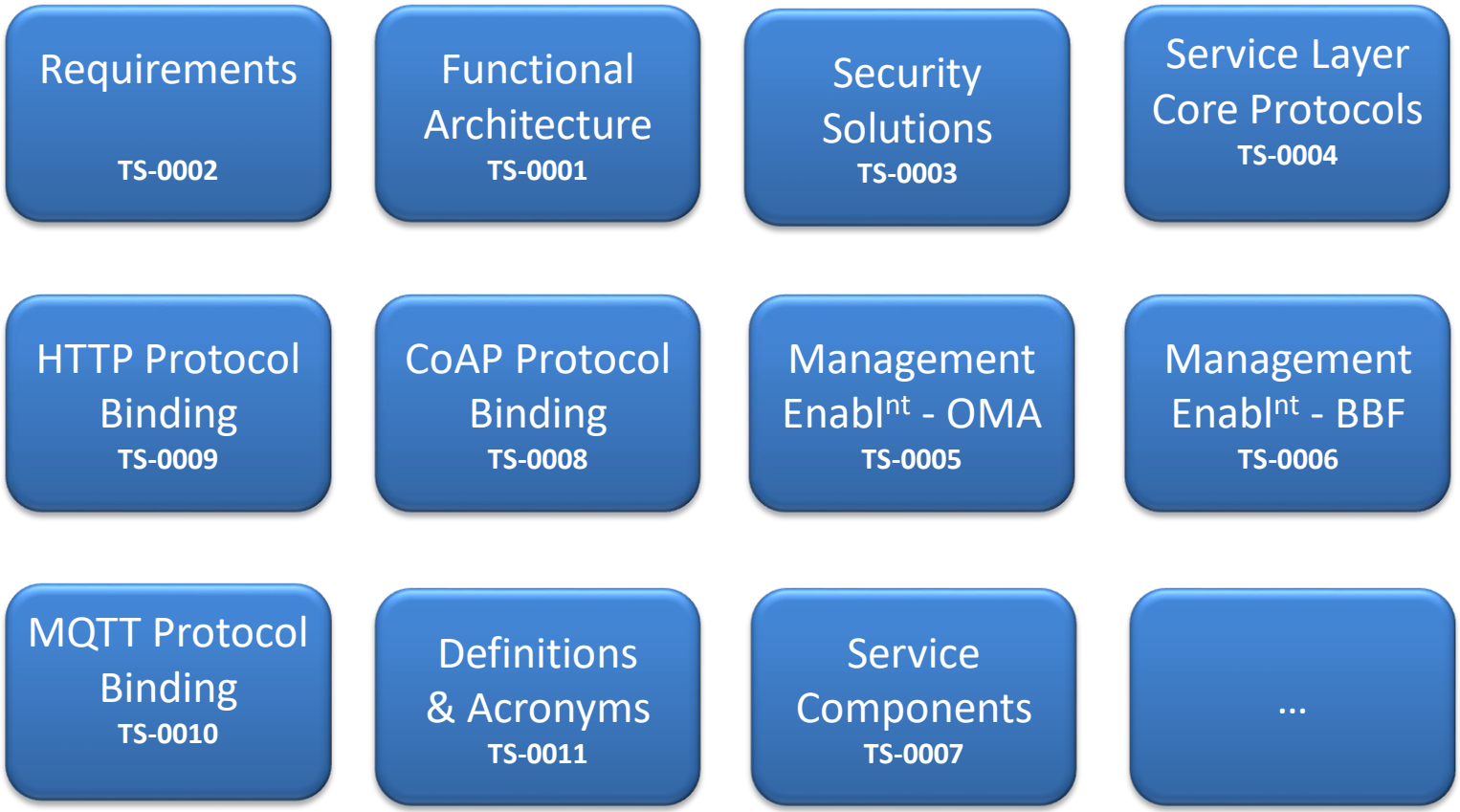
Deliverables

Technical Reports and Technical Specifications

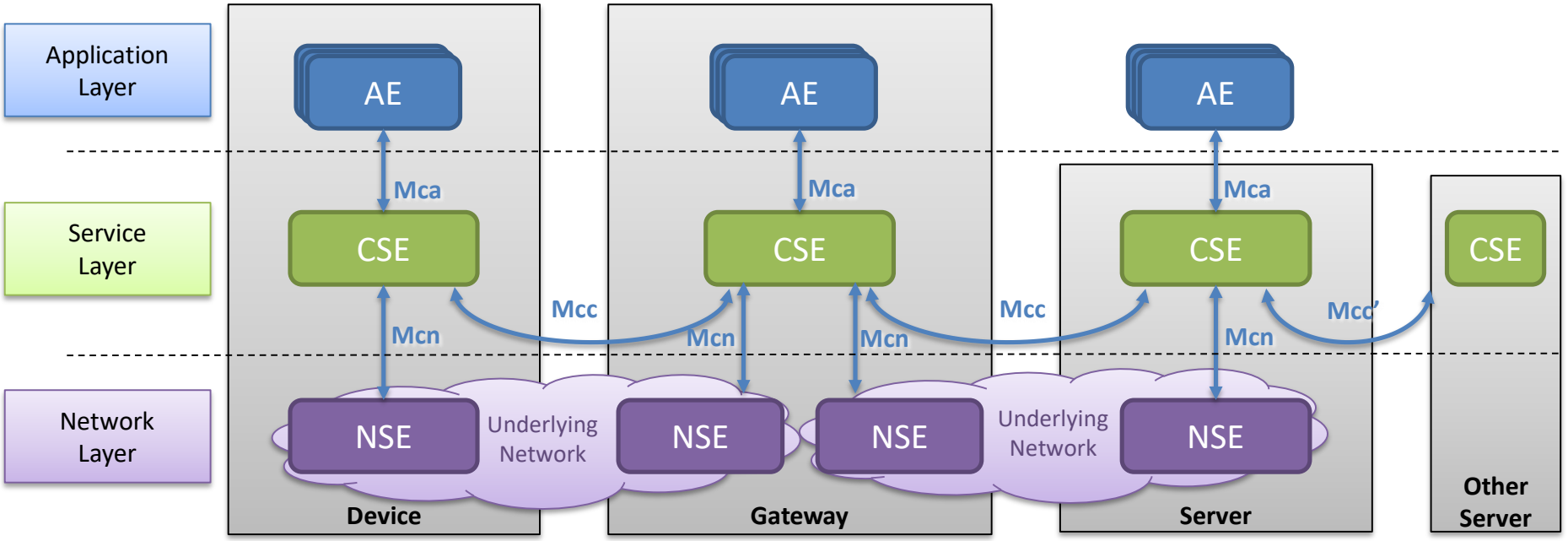
Use Cases & Requirements



Technical Specifications



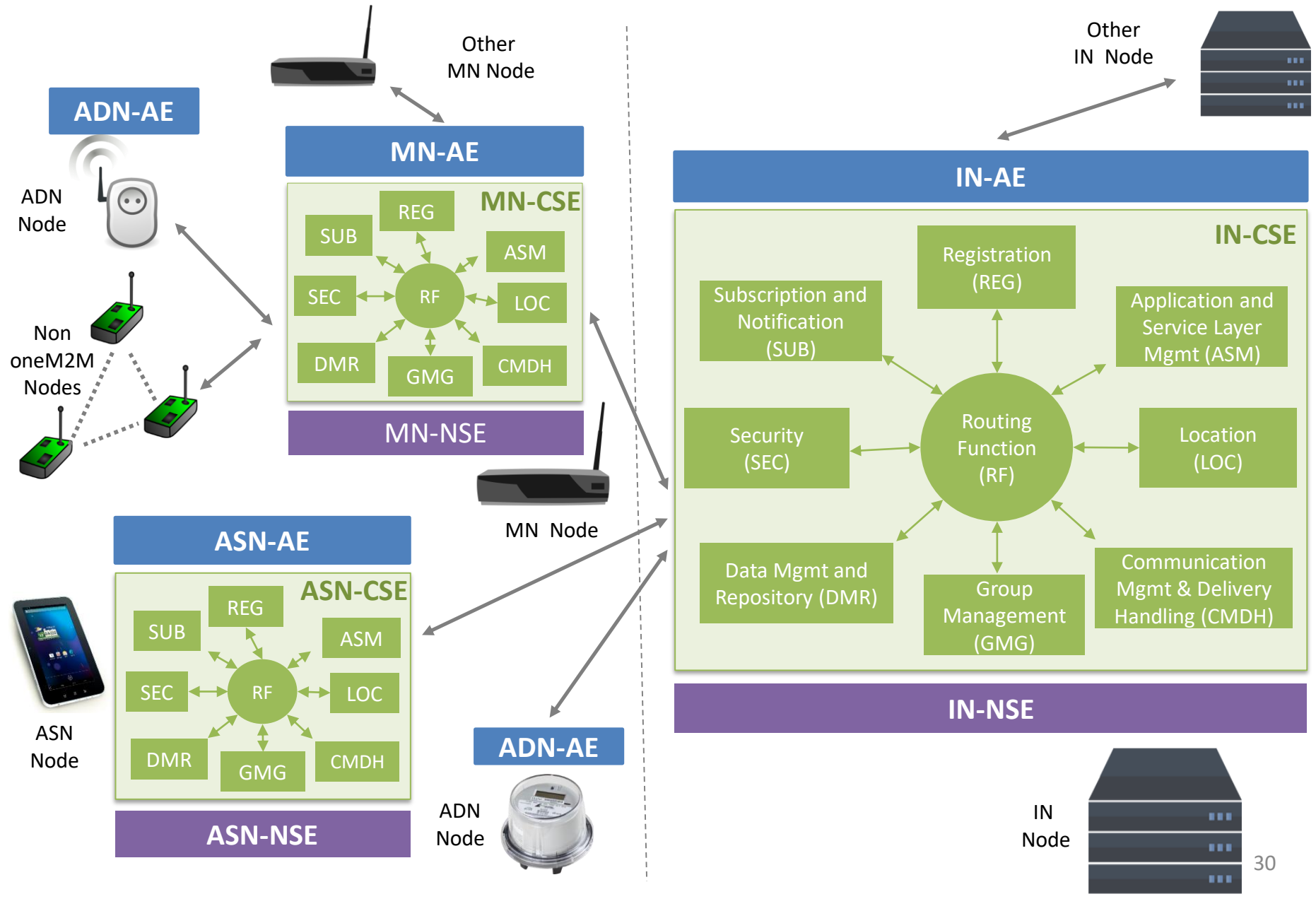
oneM2M high level architecture



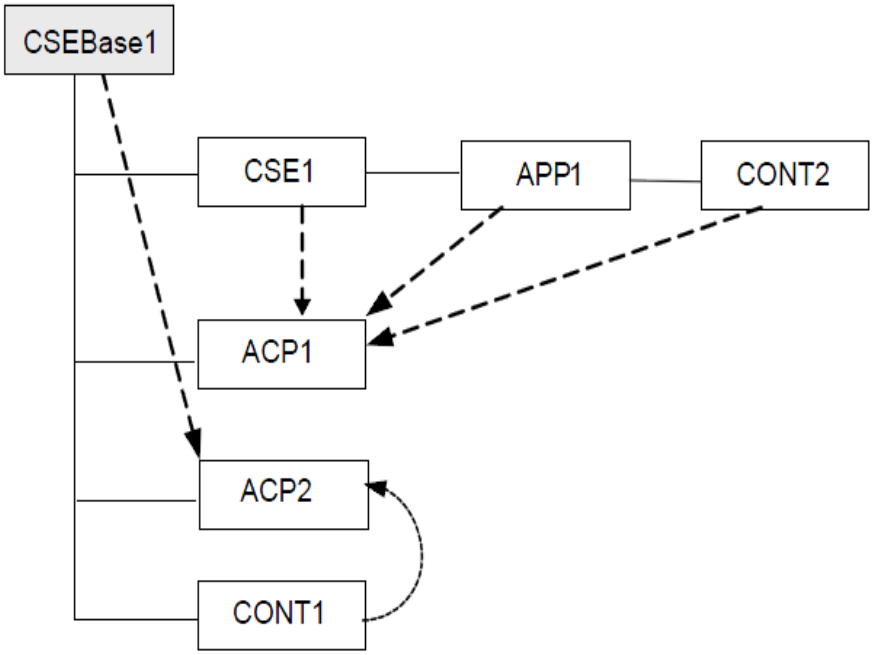
Entities: AE (Application Entity), CSE (Common Services Entity) and NSE (Network Services Entity)

Reference Point: One or more interfaces - Mca, Mcn, Mcc and Mcc'

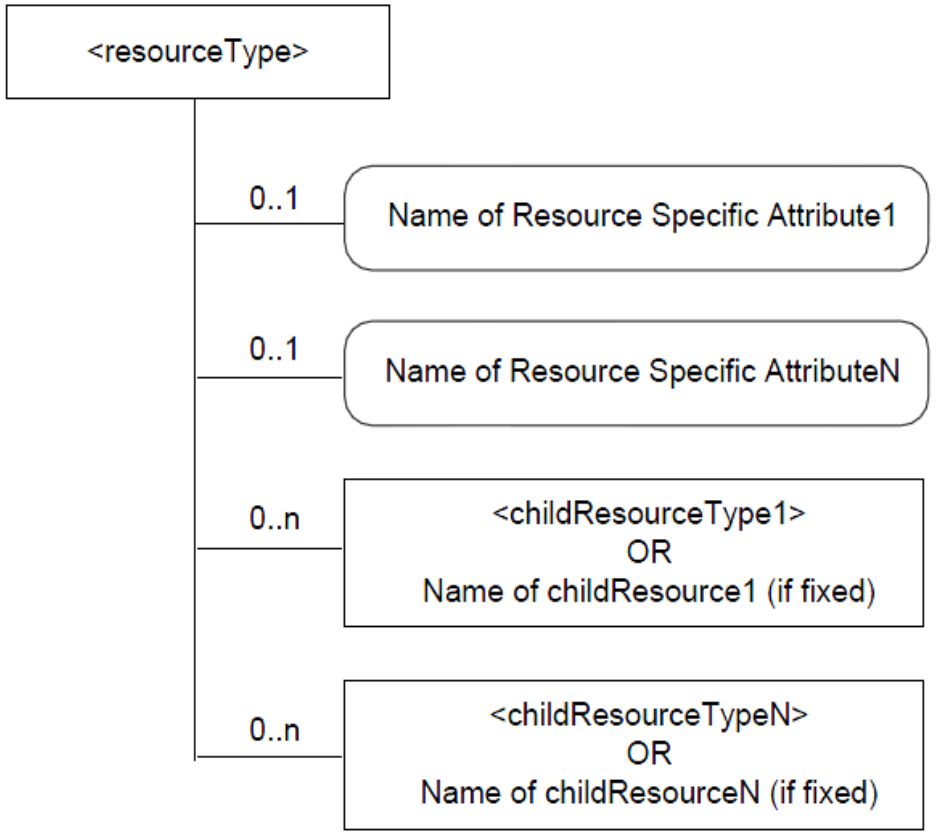
oneM2M functional architecture



OneM2M resource structure



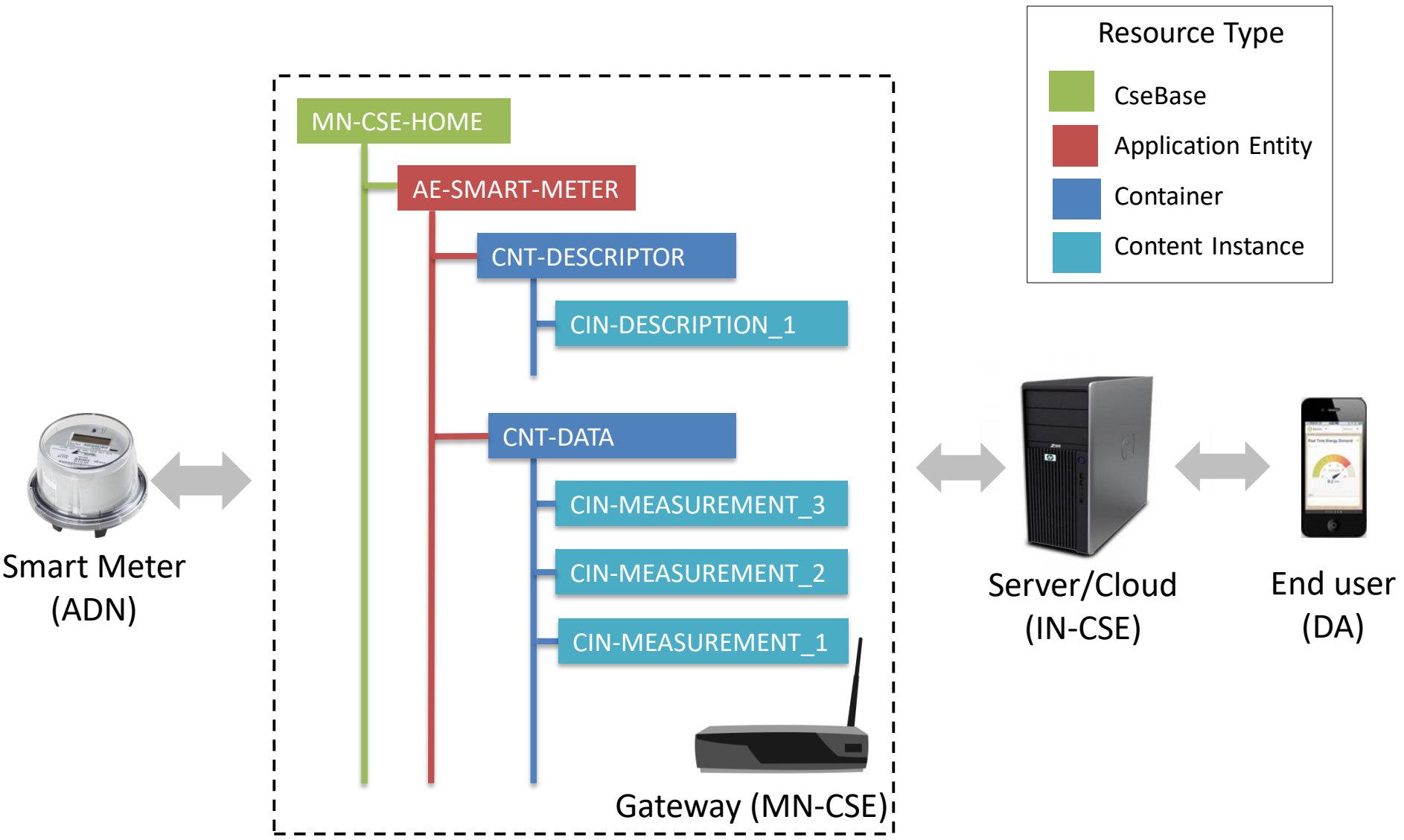
OneM2M Resource structure



Resource type representation

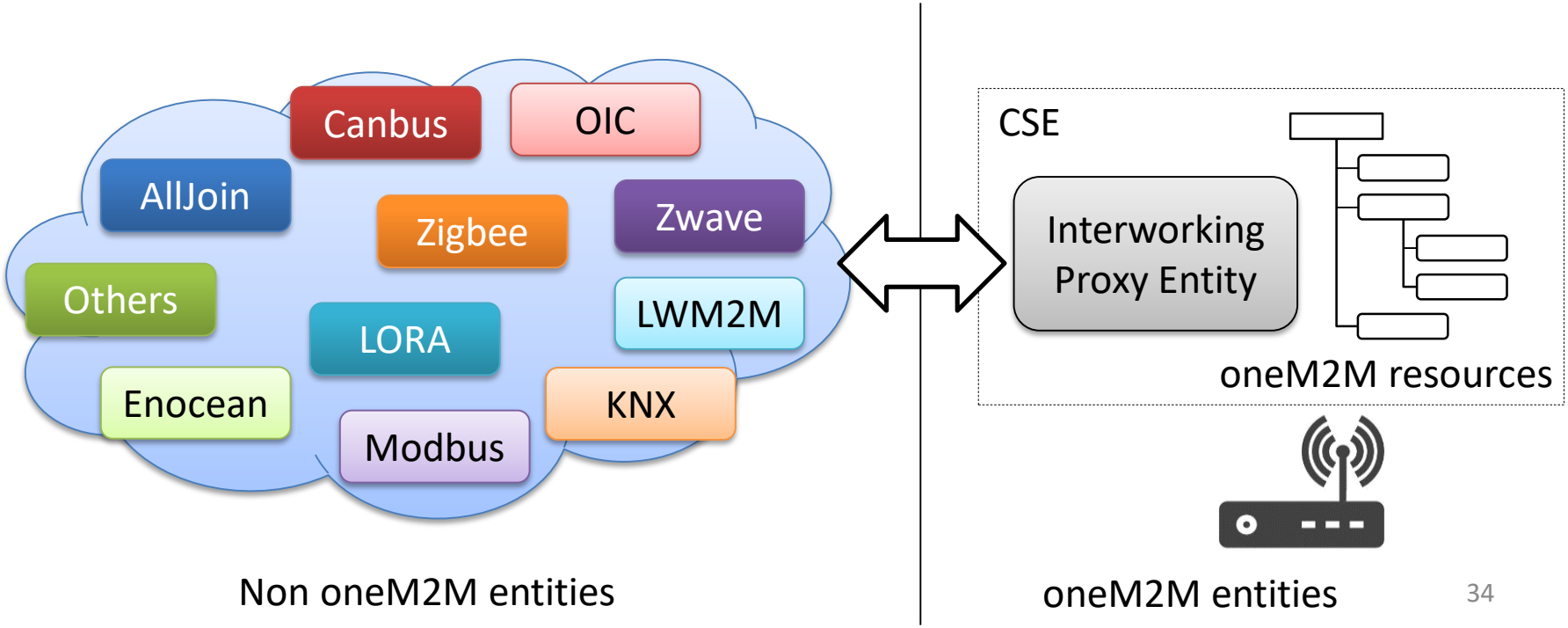
oneM2M resource types

OM2M resource tree example



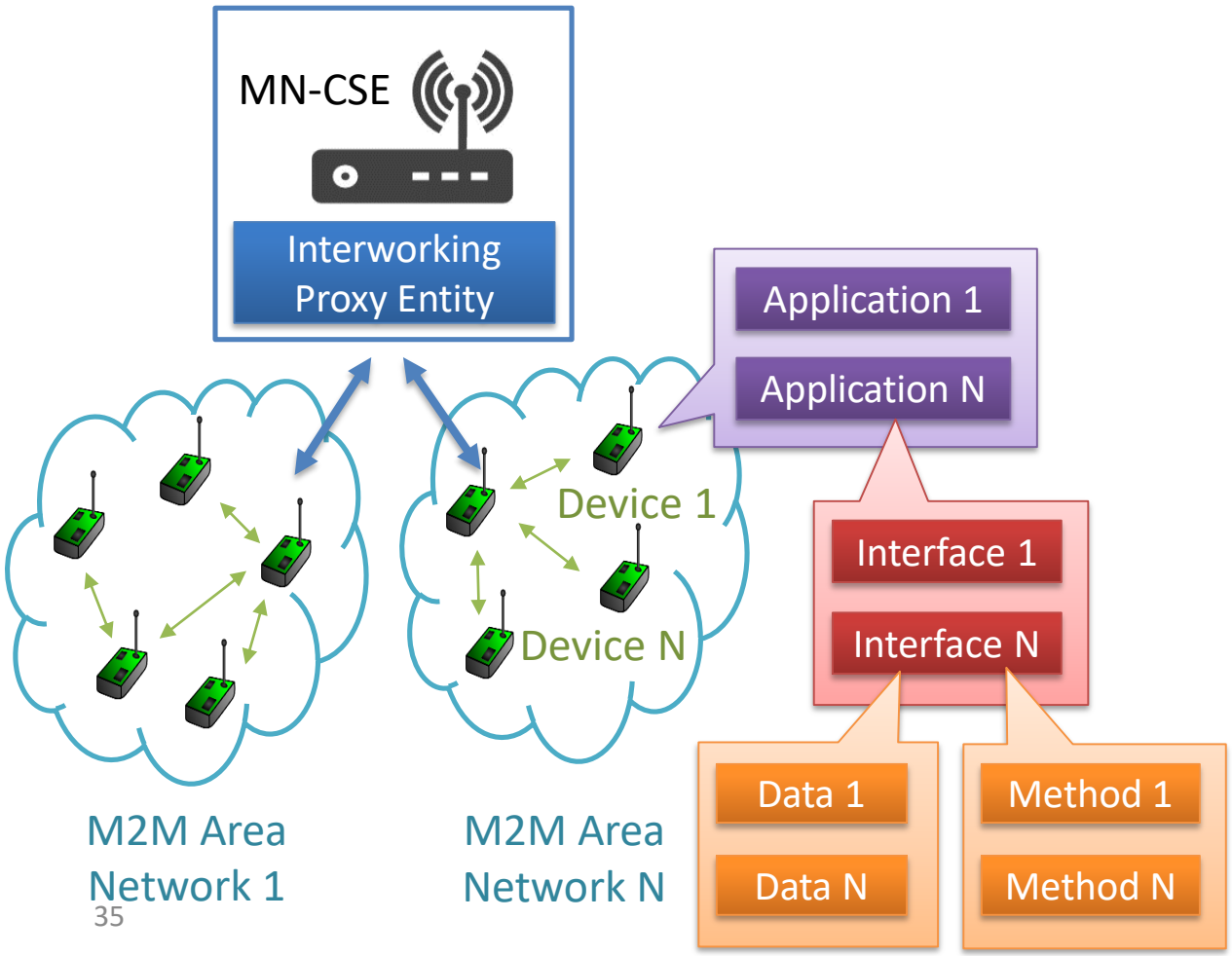
Interworking with non oneM2M Technologies

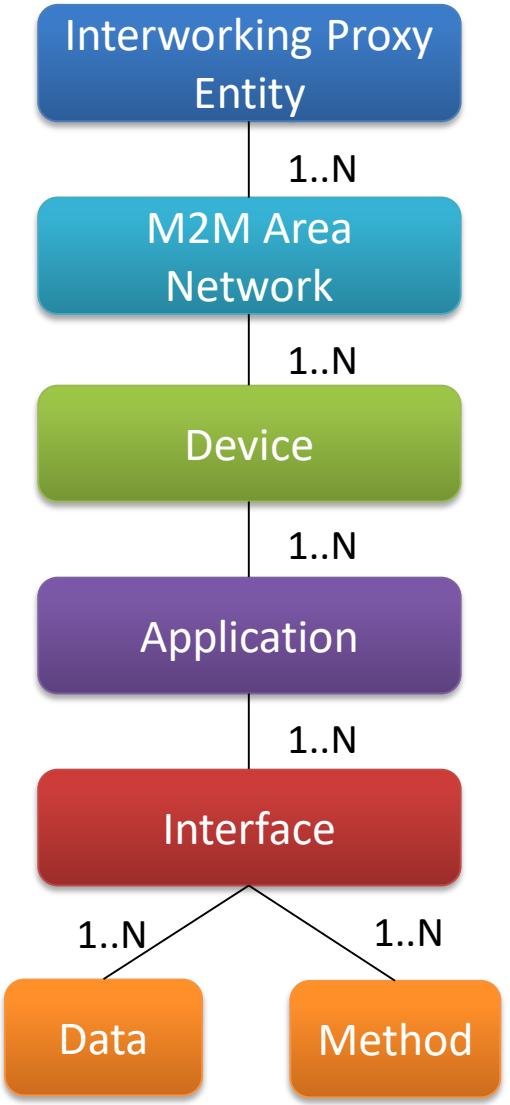
- The Interworking Proxy Entity (IPE) abstracts and maps the non-oneM2M data model to the oneM2M resources.
- Bidirectional communication between the oneM2M system and a specific technology (Monitor and Control).
- Seamless interaction between applications and devices using the oneM2M Restful API.



Generic data modeling for interworking

- Common abstract data model for non oneM2M devices.





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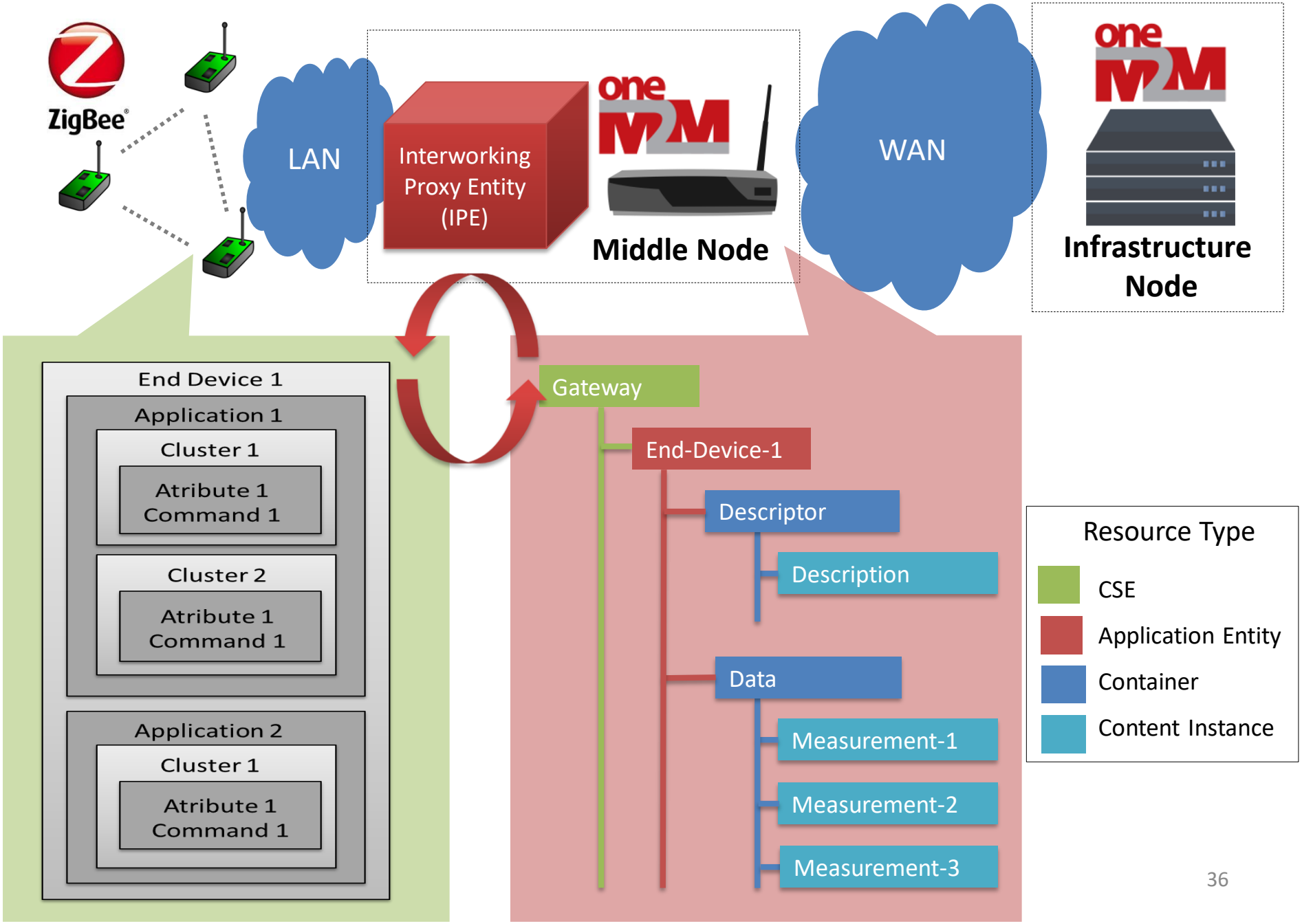
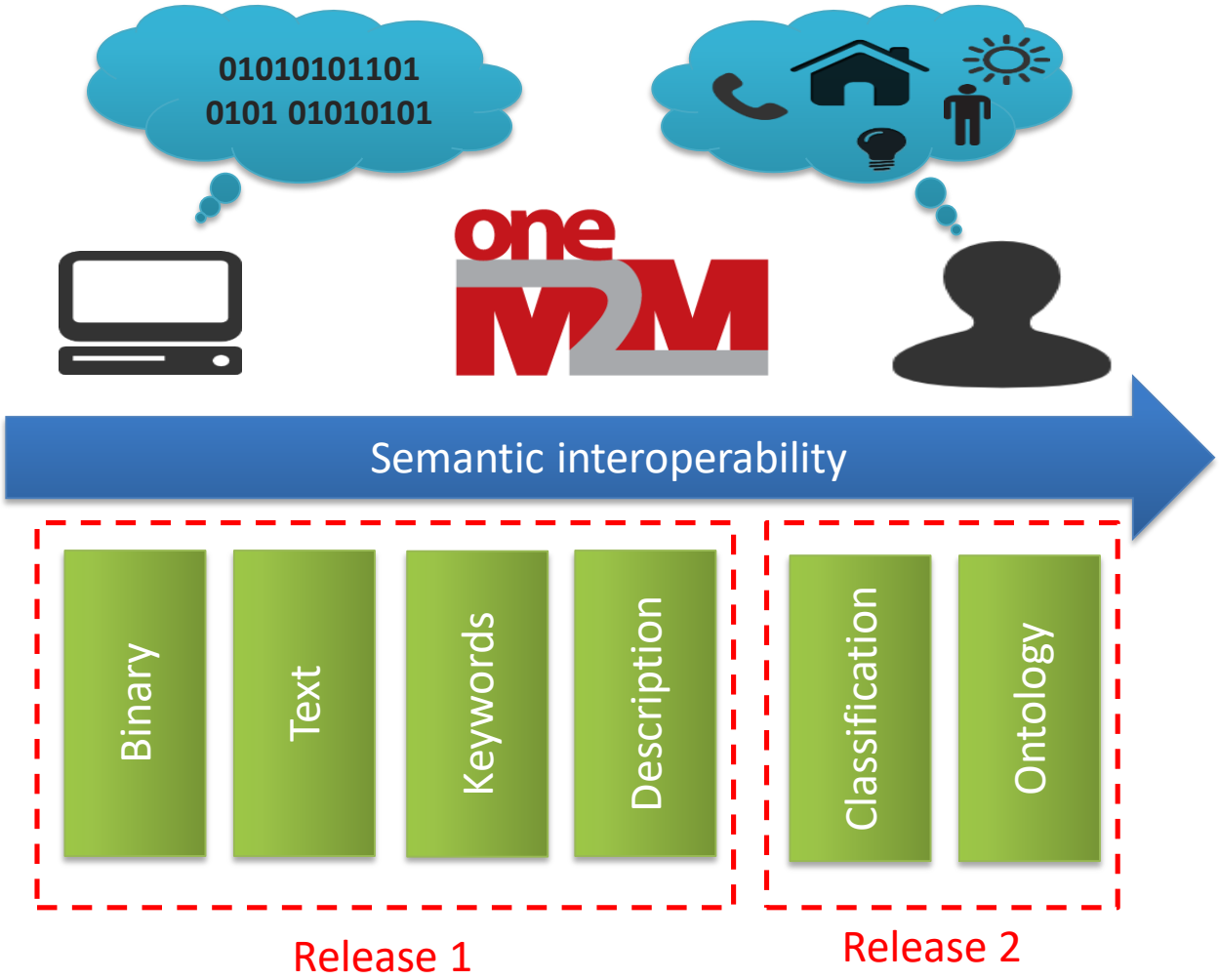
Interworking scenario example

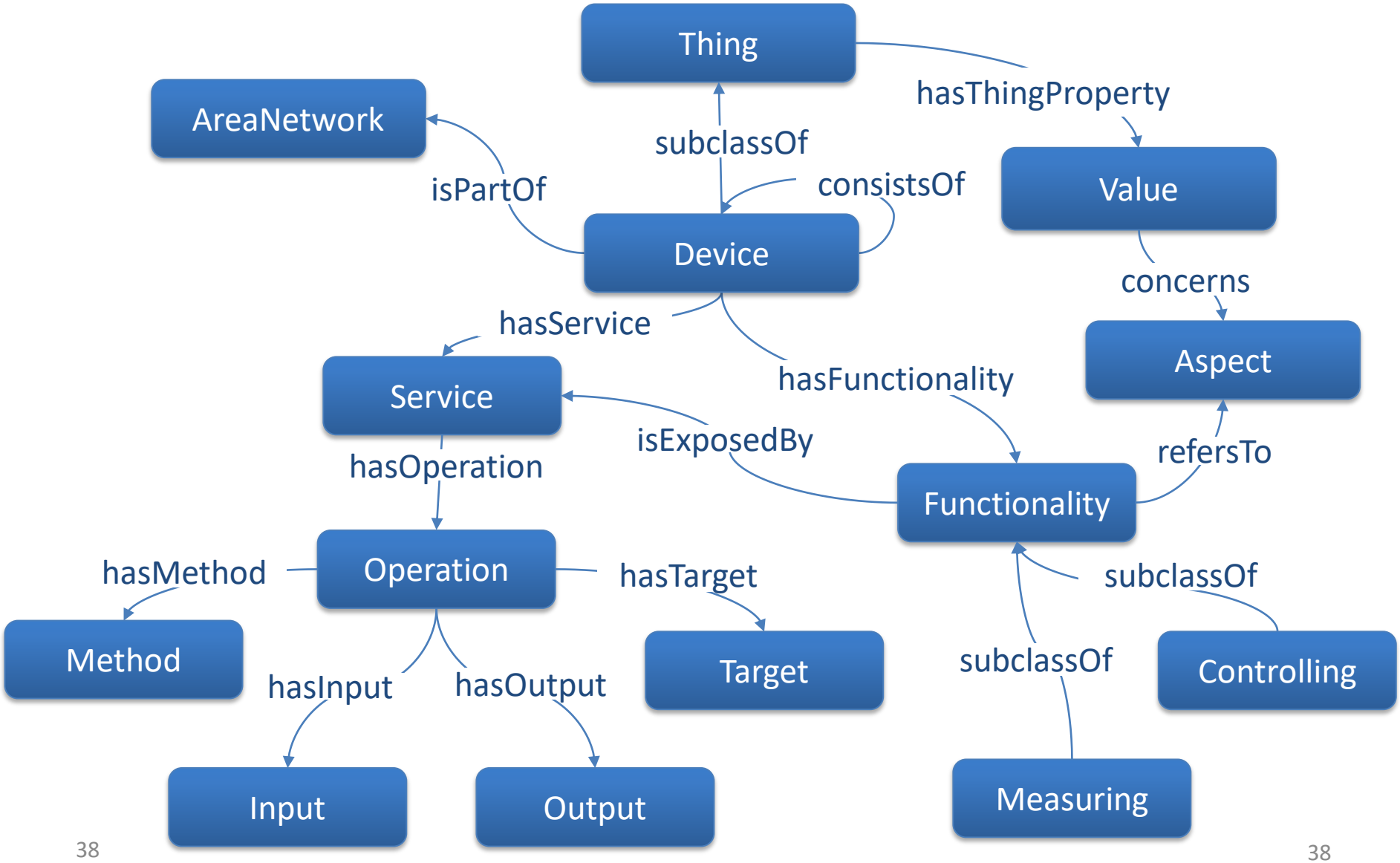


Semantic in oneM2M

- oneM2M offered minor semantic enhancement in release-1 and aims to provide full semantic support in the next releases.



oneM2M base ontology model



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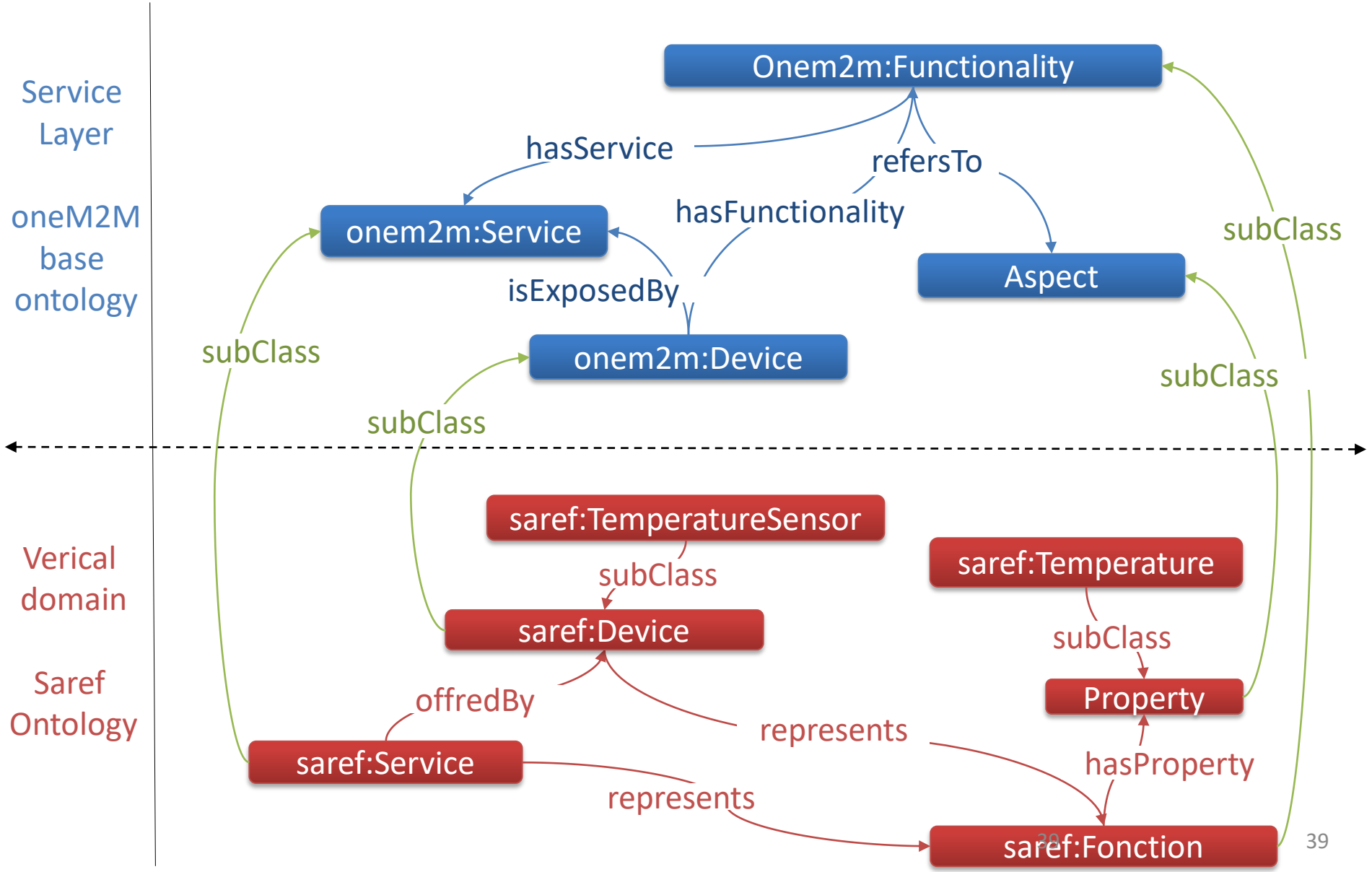
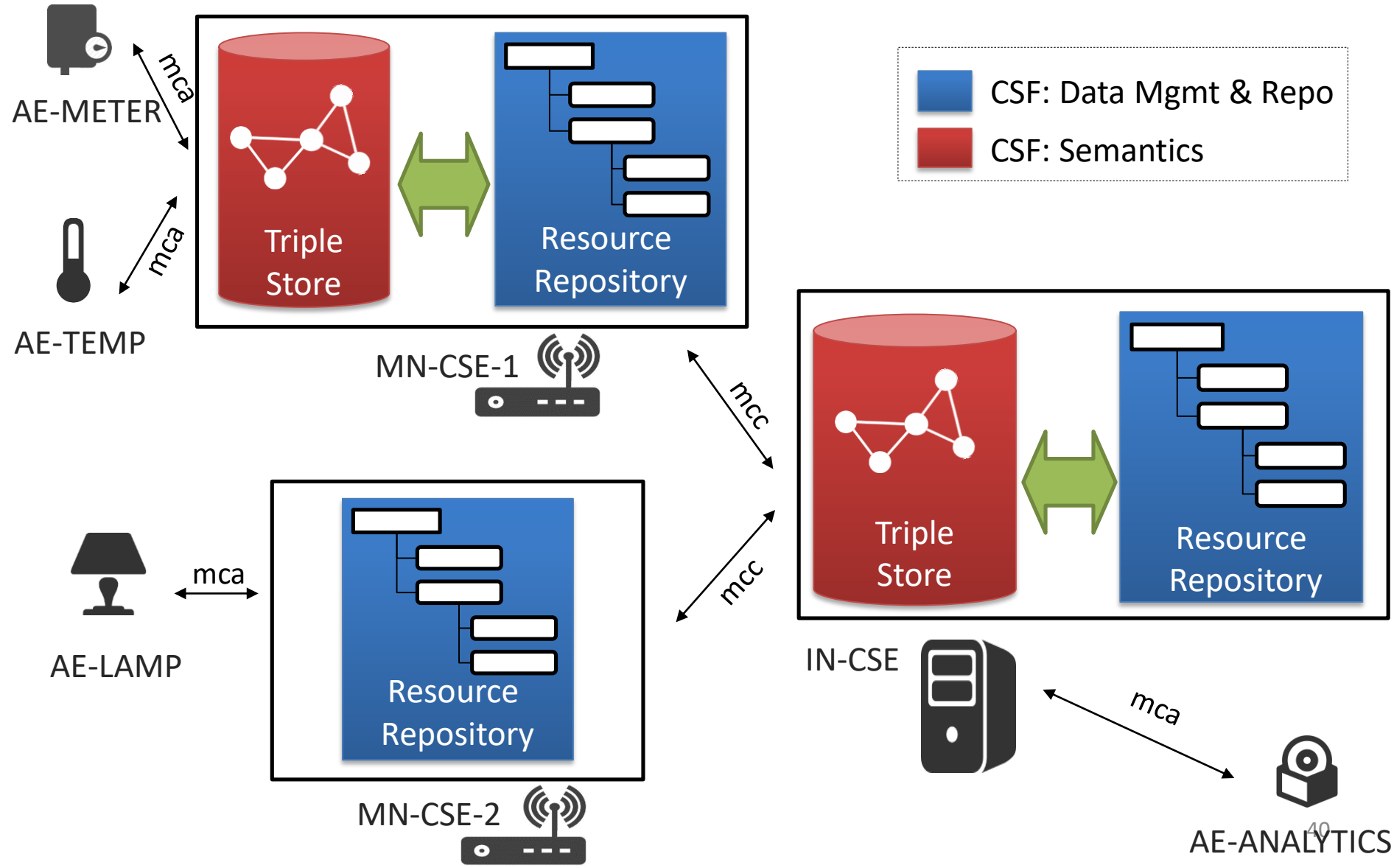
Mapping to vertical ontologies

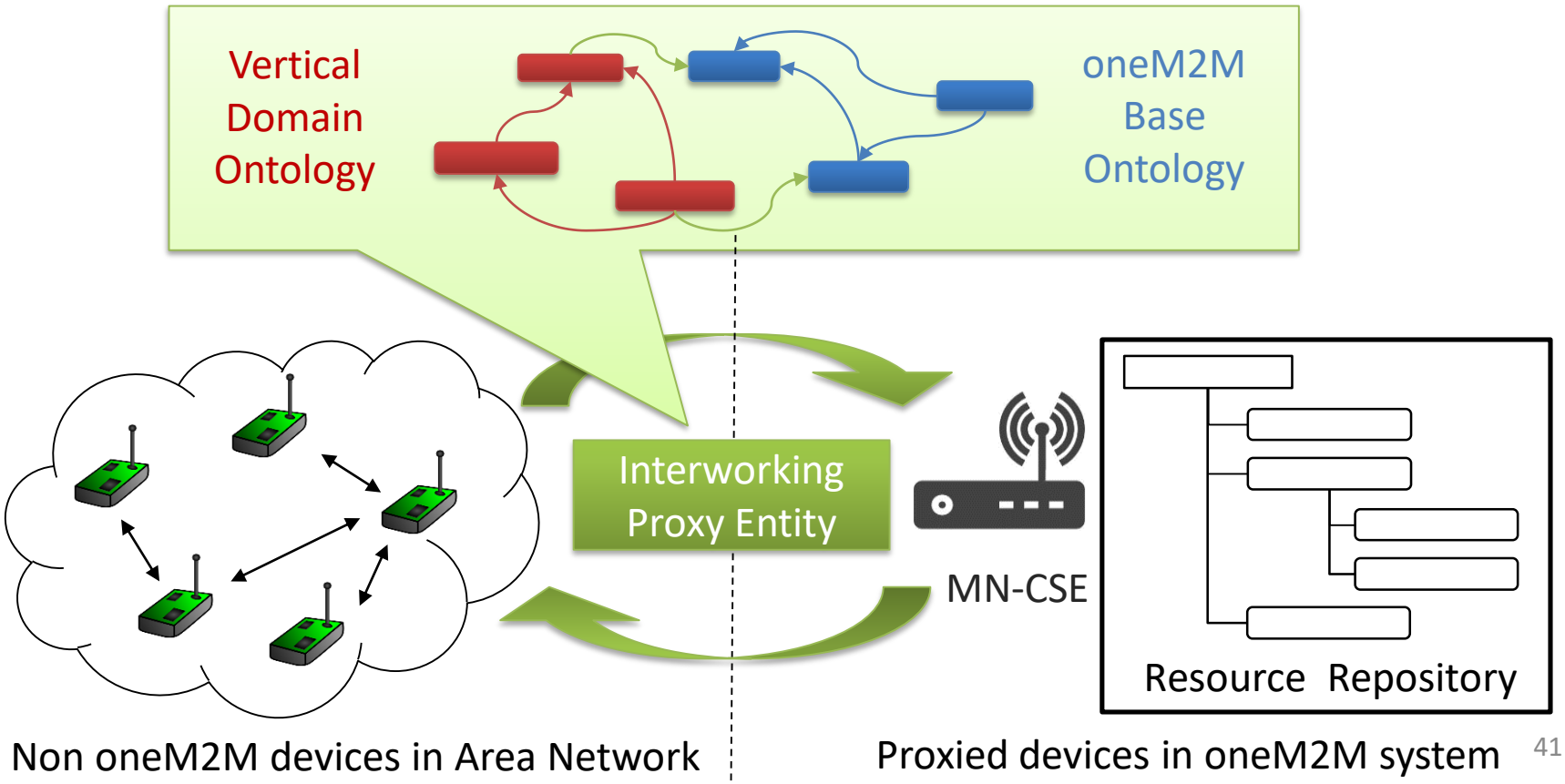


Semantic oneM2M archtiecture

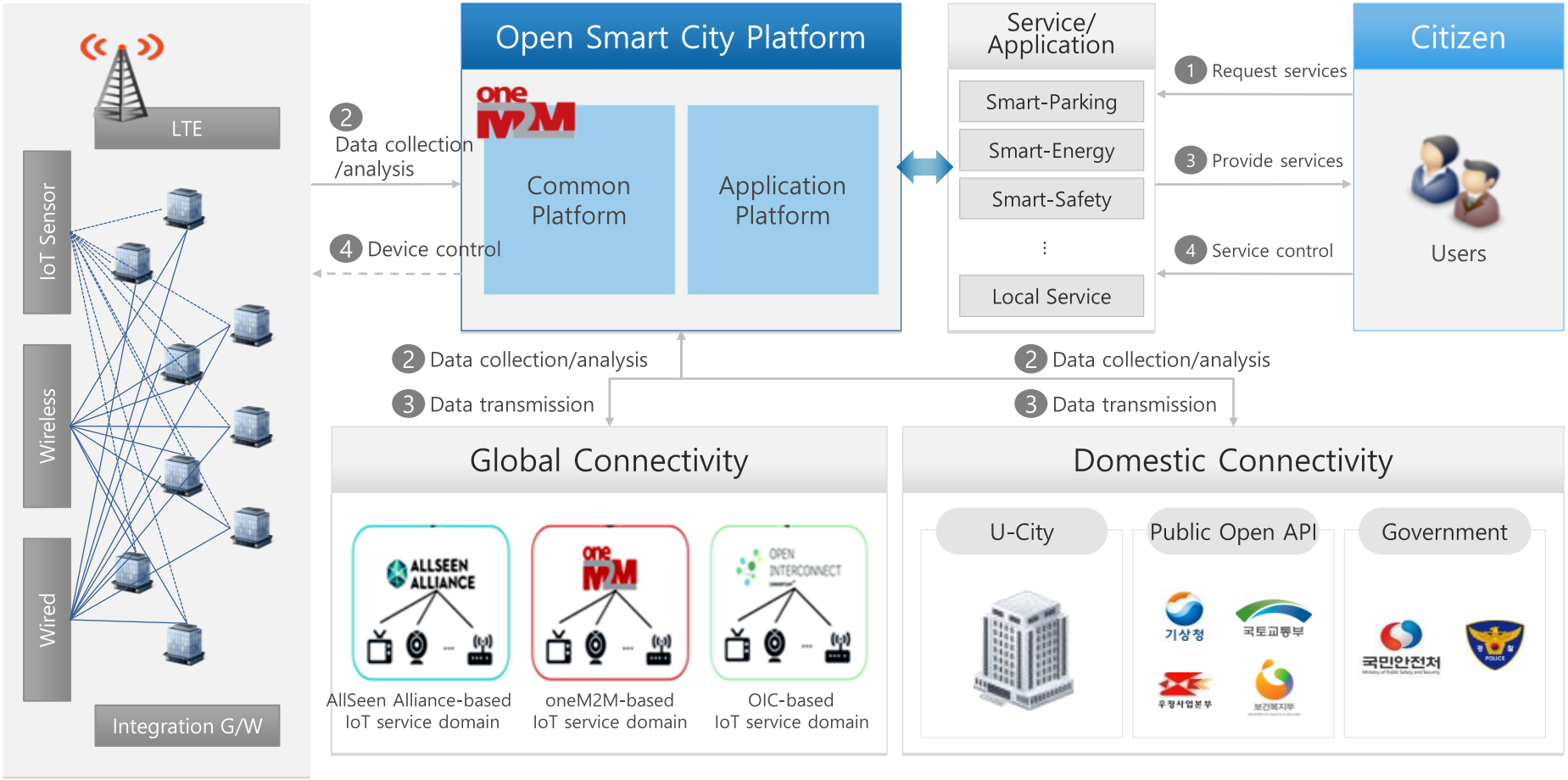


Generic interworking using semantic

- Non oneM2M devices are described using the oneM2M base ontology + domain specific extensions.
- The Interworking Proxy Entity translates the ontology instance to resources on the CSE based on pre-defined instantiation rules.



oneM2M based smart city deployment example - Busan

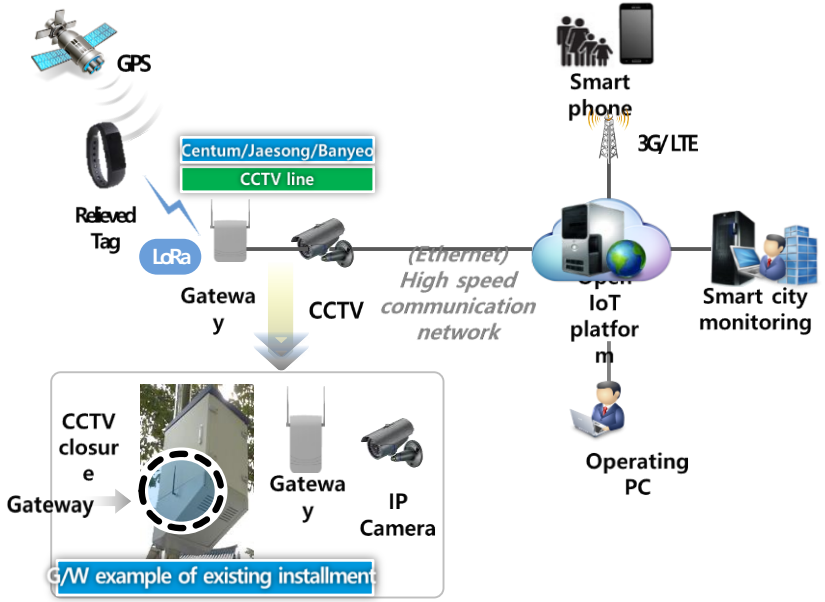


Source: SKT

Smart city Busan use case examples

Safety service for Children and the old

✓ A Smart location management and a service of smart education supporting which are based on the free communications for the disadvantaged people such as the demented elderly, disabled people, children, infants

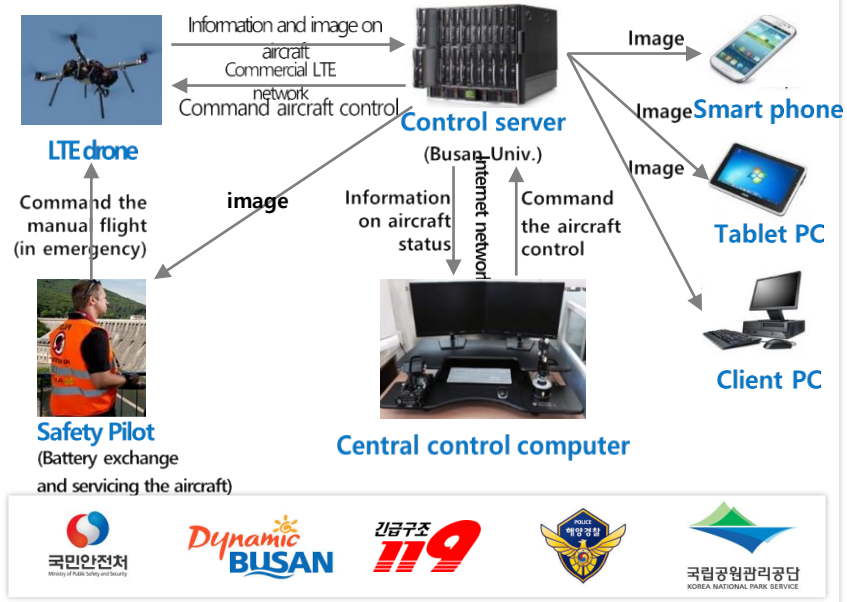


Cost saving due to the first utilization of service based on LPWA(LoRa)

Provision of Integrated service CCTV image, health check with location service

Smart marine safety based on drone

✓ In order to prevent coast and marine accidents, a drone with device of video transmission and automated pilot devices based on LTE controls the site in real-time.



Application of auto pilot control with only domestic technology

The national first unmanned marine surveillance /Implementation of control system

Source: SKT

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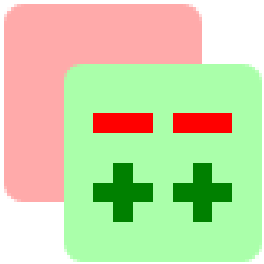
Eclipse: open source ~~IDE~~ ?
A community of open source projects

Advanced Infrastructure for development



Gerrit

Eclipse Working Groups

Eclipse IoT projects

Mihini

The Mihini project delivers an embedded runtime running on top of Linux, that exposes an high-level Lua API for building Machine-to-Machine...

Paho

The Paho project has been created to provide scalable open-source implementations of open and standard messaging protocols aimed at new, existing, and emerging applications for Machine-to-Machine...

Eclipse SCADA

SCADA (supervisory control and data acquisition) is a type of industrial control system (ICS). Industrial control systems are computer controlled systems that monitor and control industrial processes...

Ponte

The following are the plan items for the Ponte project: Build a reusable solution for bridging several M2M protocols to REST: Formalize a REST API for reading, writing and...

Concierge

Concierge is a small-footprint implementation of the OSGi Core Specifications R5 standard optimized for mobile and embedded...

Mosquitto

Mosquitto provides a lightweight server implementation of the MQTT and MQTT-SN protocols, written in C. The reason for writing it in C is to enable the server to run on machines which do not even have...

Eclipse SmartHome

The Eclipse SmartHome project is a framework that allows building smart home solutions that have a strong focus on heterogeneous environments, i.e. solutions that deal with the integration of...

Kura

Kura aims at offering a Java/OSGi-based container for M2M applications running in service gateways. Kura provides or, when available, aggregates open source implementations for the most common...

Krikkit

The Krikkit architecture is a publish/subscribe mechanism where rules/policies are registered on edge routers/gateways that have visibility into and communicate with...

OM2M

The OM2M project is an open source implementation of the ETSI M2M standard. It provides a framework for developing services independently of the underlying network and aims to facilitate deployment of...

Californium (Cf) CoAP Framework

Californium (Cf) is an open source implementation of the Constrained Application Protocol (CoAP). It is written in Java and targets unconstrained environments such as back-end service infrastructures...

For more details see: http://iot.eclipse.org/community.html

OM2M contributors, users and interested parties

OM2M architecture

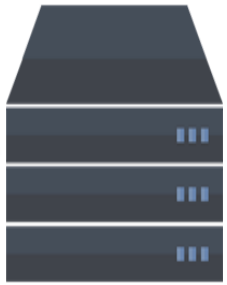
End user devices

HTTP/CoAP

Java OSGi Alliance

Data Analytic

HTTP/CoAP



HTTP/CoAP

OM2M Connecting things

M2M Server

HTTP/CoAP

SCADA Interface

Network domain

MQTT.ORG

MQTT

Java OSGi Alliance

OM2M Connecting things

M2M gateway

Device and Gateway domain

PHIDGETS

ZIGBEE

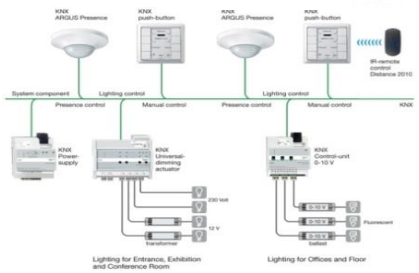
ZigBee®

6LoWPAN

6LoWPAN

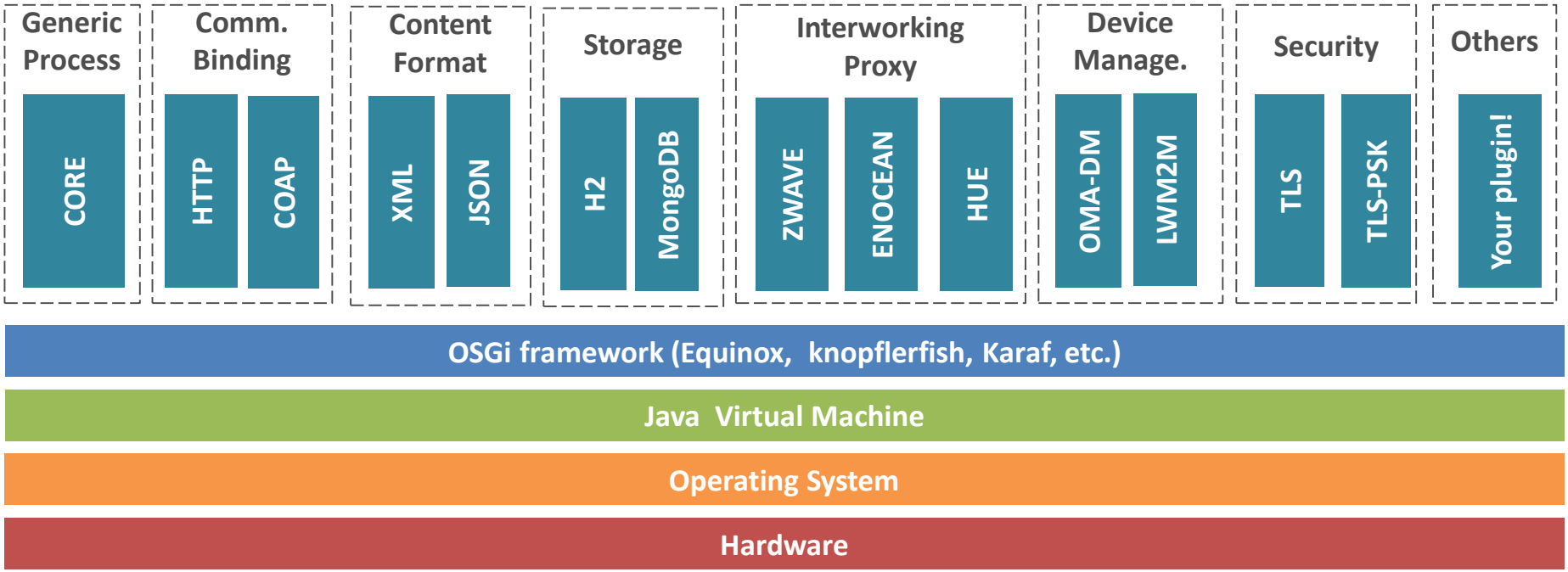
KNX

KNX

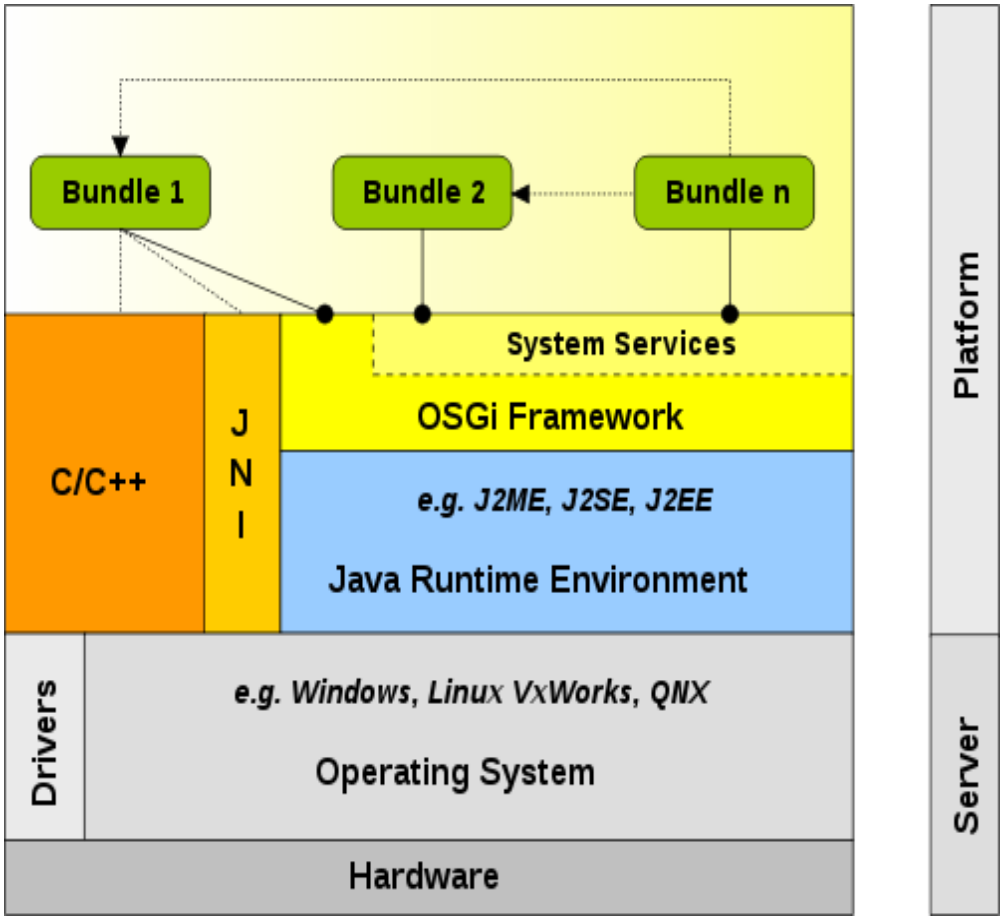


OM2M Building Blocks

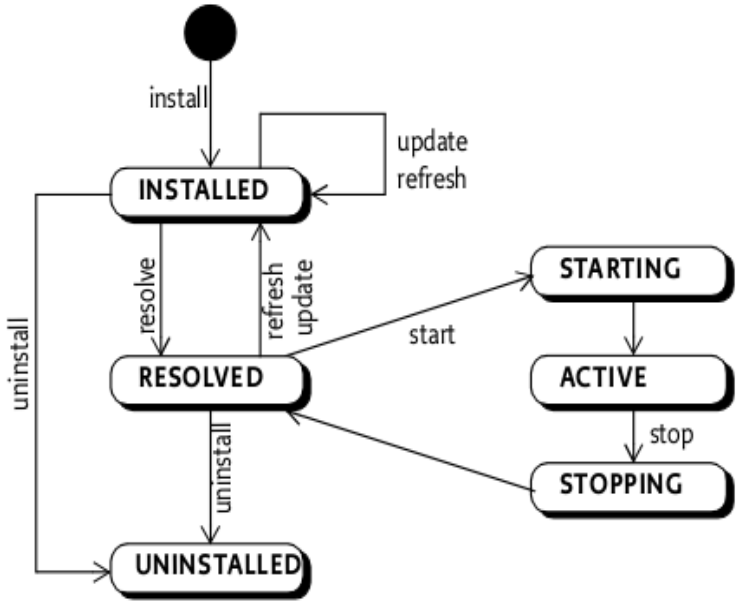
- OM2M is a java platform running on top of an OSGi runtime
  - Highly extensible via plugins.
  - Flexible OSGi container: Equinox, Knopflerfish, or others.
  - Flexible database: SQL or NoSQL.
- Each CSE includes required plugins and is build as an Eclipse product using maven and Tycho.



OM2M OSGi-based platform



OSGi Architecture

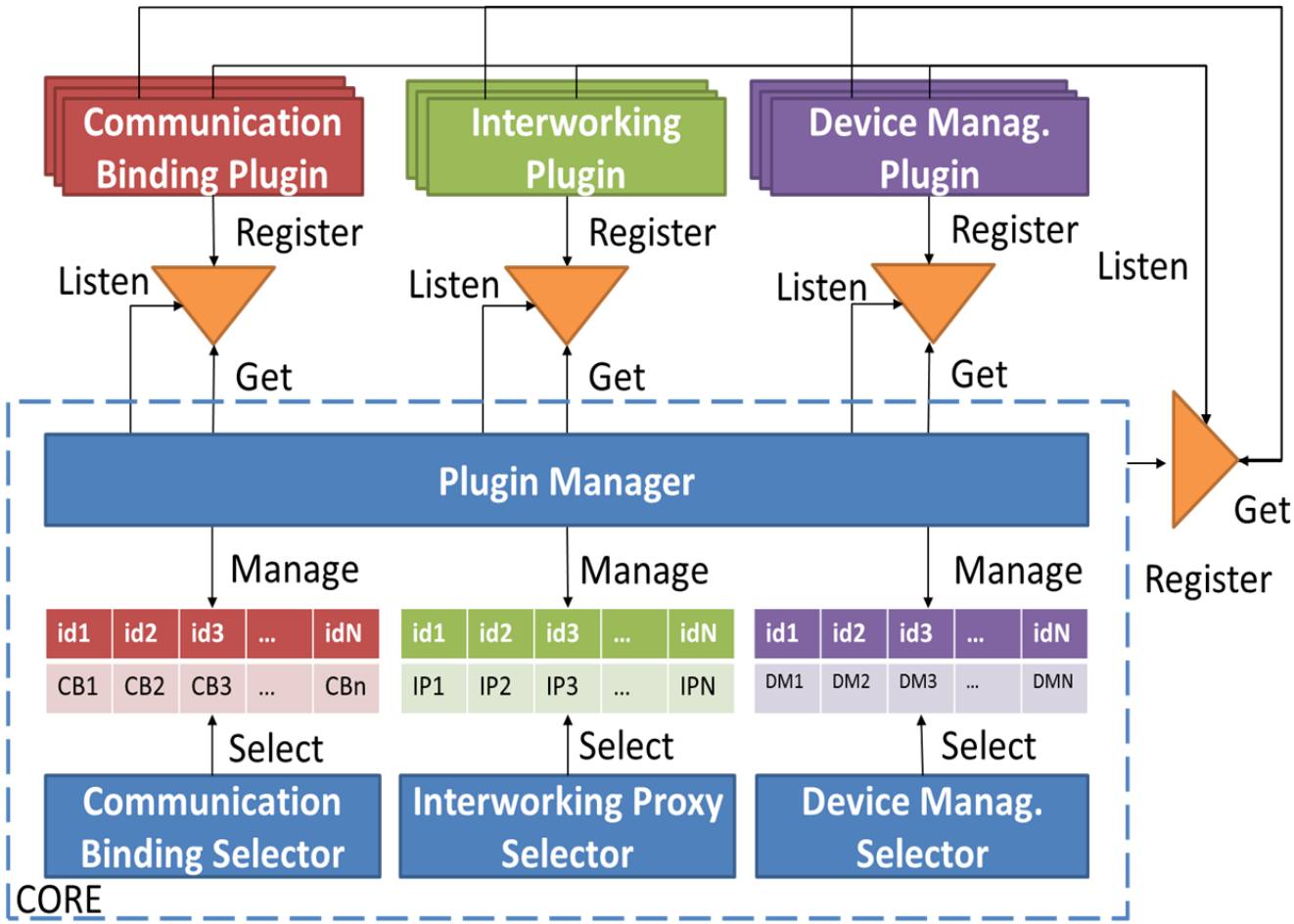


bundle life cycle

OM2M Service discovery

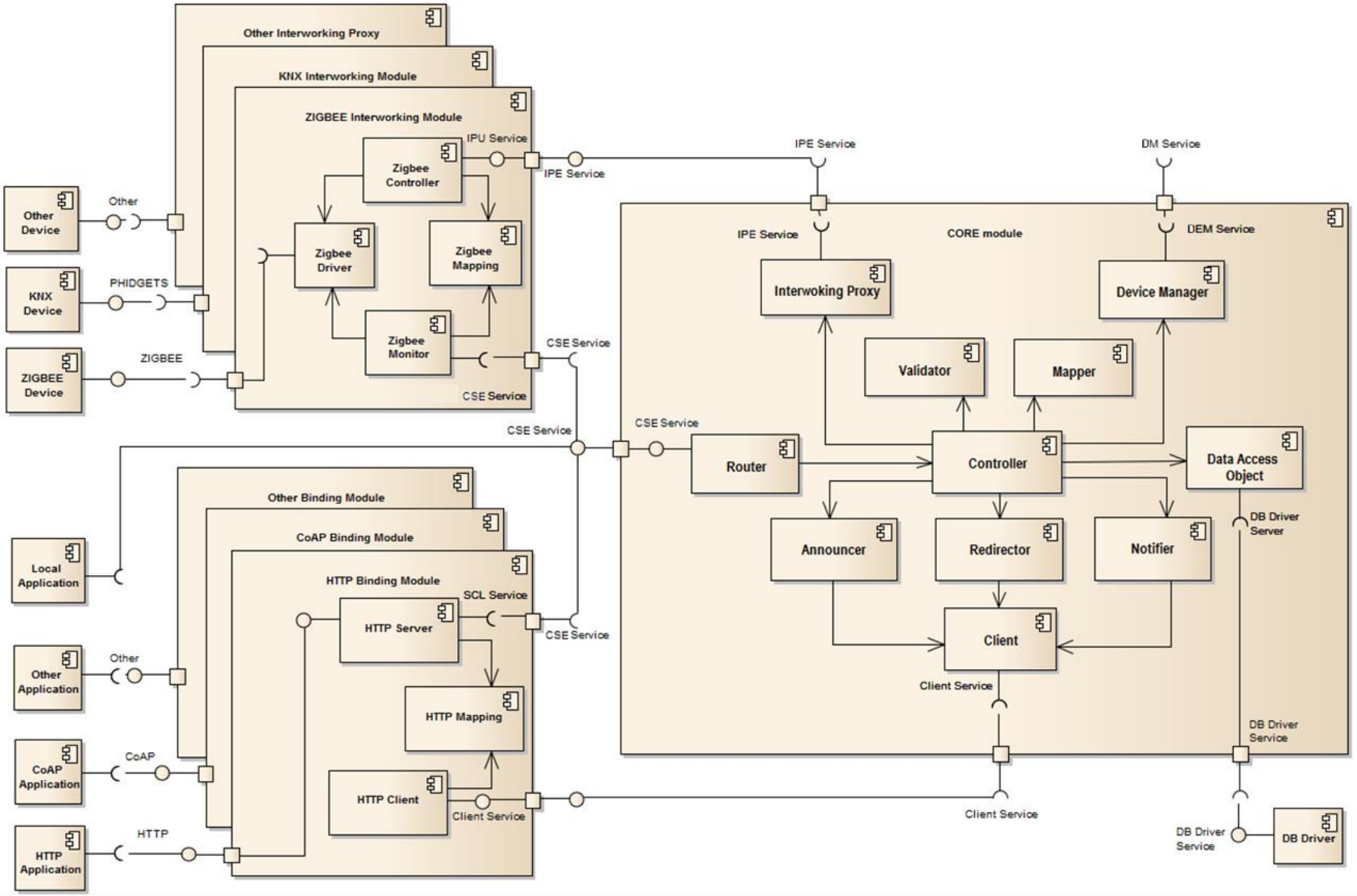
Extension through three axes:

- Communication binding,
- Interworking,
- Device management

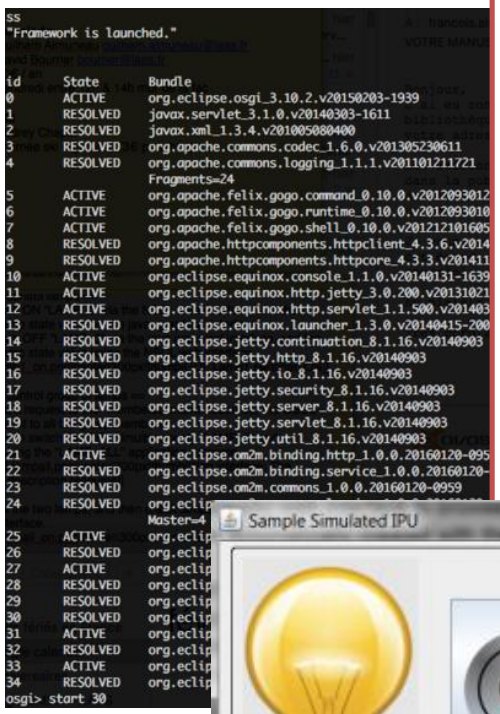


OM2M service discovery and management

OM2M components diagram overview



OM2M graphical interfaces



- mn-name
  - acp_admin
  - acpae-924510951
  - acpae-987420501
  - acpae-268930119
  - LAMP_0
    - DESCRIPTOR
      - cin_586540630
    - DATA
  - LAMP_1
  - LAMP_ALL
  - in-name

Attribute	Value
ty	4
ri	cin-586540630
pi	/mn-cse/cnt-766321079
ct	20160120T121007
lt	20160120T121007
st	0
cnf	application/obix
cs	658
con	

Attribute	Value
type	LAMP
location	Home
appId	LAMP_0
getState	/mn-cse/mn-name/LAMP_0/DATA/la
getState(Direct)	/mn-cse/mn-name/LAMP_0?op=getStateDirect&lampid=LAMP_0
switchON	/mn-cse/mn-name/LAMP_0?op=setOn&lampid=LAMP_0
switchOFF	/mn-cse/mn-name/LAMP_0?op=setOff&lampid=LAMP_0
toggle	/mn-cse/mn-name/LAMP_0?op=toggle&lampid=LAMP_0

Outline

- The vision of IoT, stakes and challenges
- oneM2M standard, common architecture for IoT
- Eclipse OM2M, open source oneM2M-based platform
- Sensinov IoT solutions and partnerships

Sensinov IoT Platform

- Global IoT service platform for cross-domain interoperability easing mass-scale deployment in various domains for smart cities, factories of the future, health care, and connected cars.

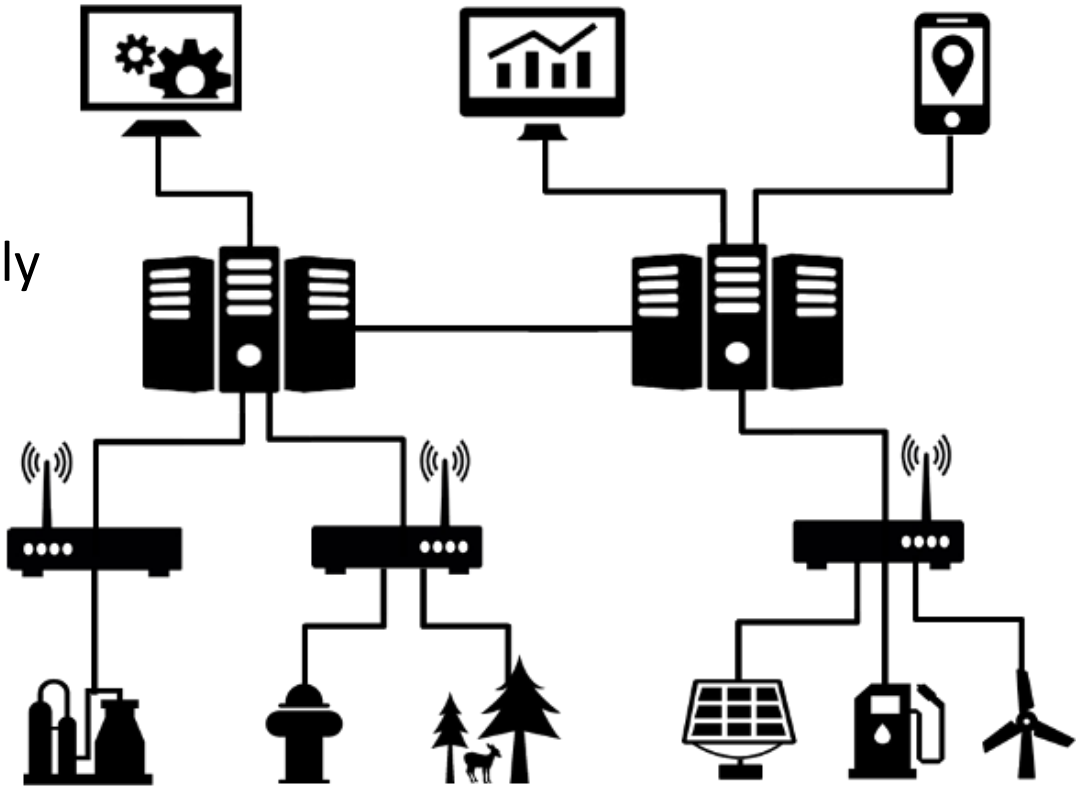
- Initial focus on Service Providers and Smart Cities.

- Our capabilities make us unique in achieving time to market for our customers through a flexible platform and tools for technology integration.

Interworking Made Easy

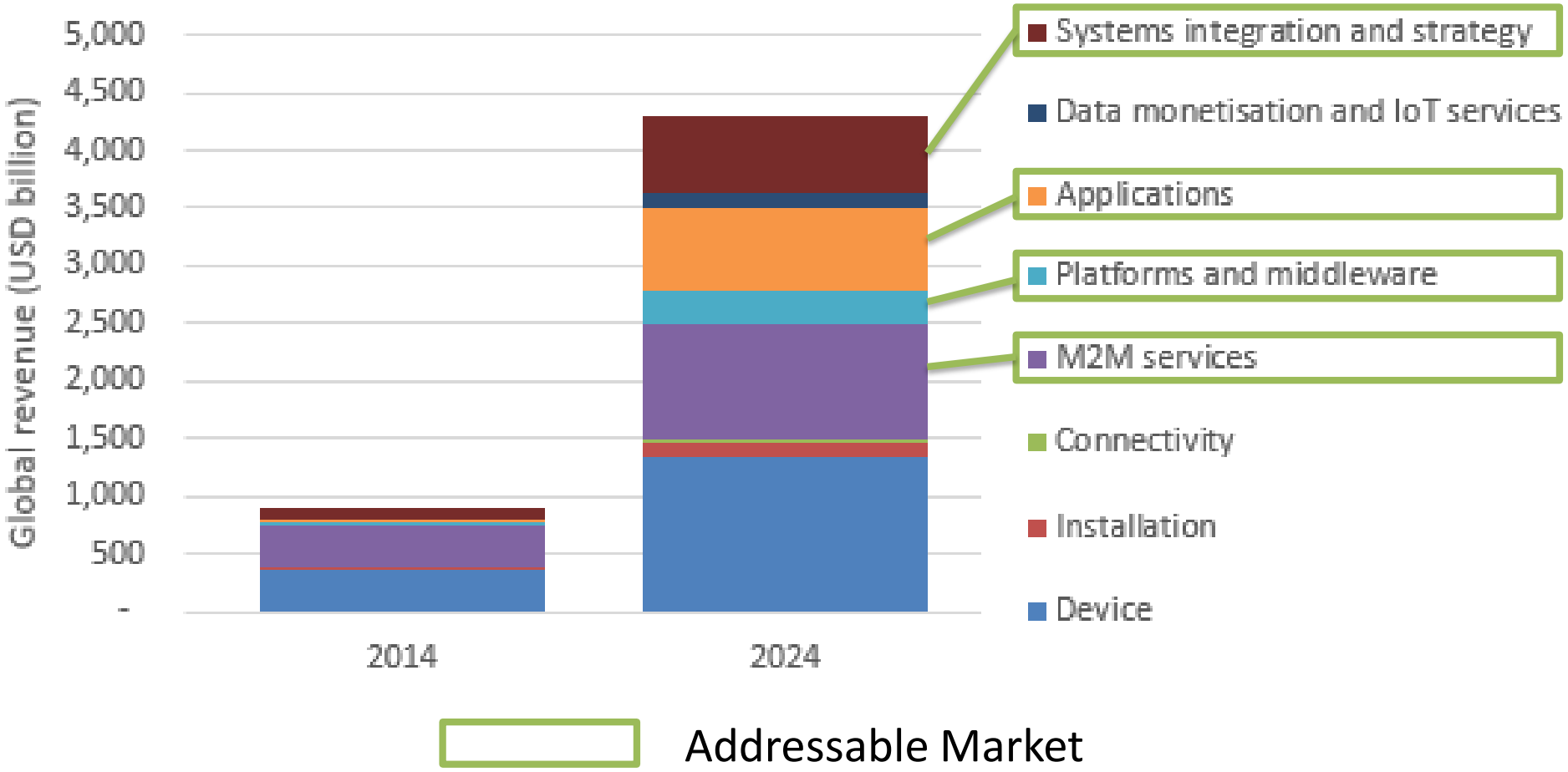
- Sensinov intends to become a fast-growing IoT business targeting devices, gateways and cloud applications for mass-scale IoT solutions.

- We help our customers expand their businesses and services independently of the underlying technologies using an integration platform connecting all kind of devices and applications.



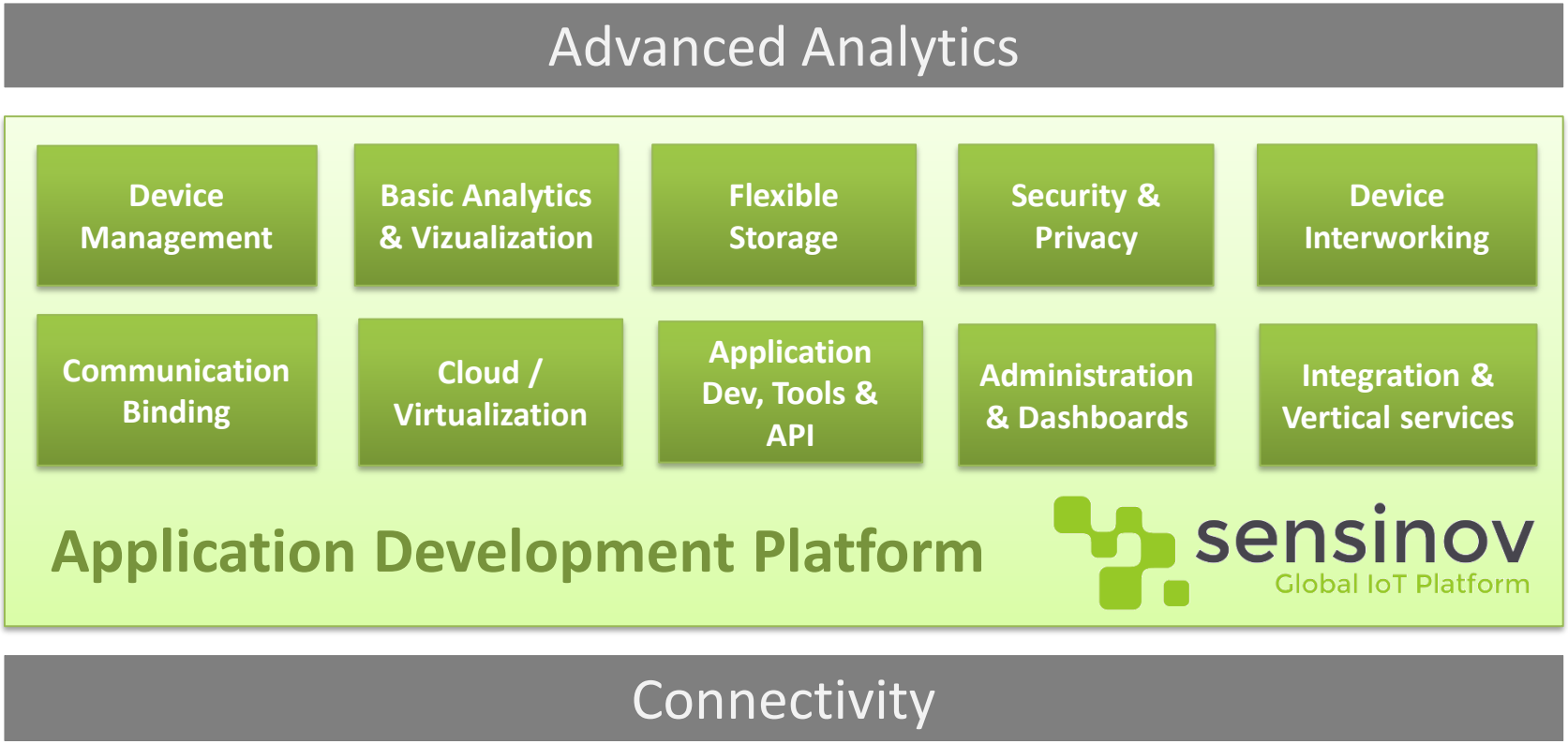
Total Addressable Market

Global IoT Opportunity (Source: Machina Research, 2015)



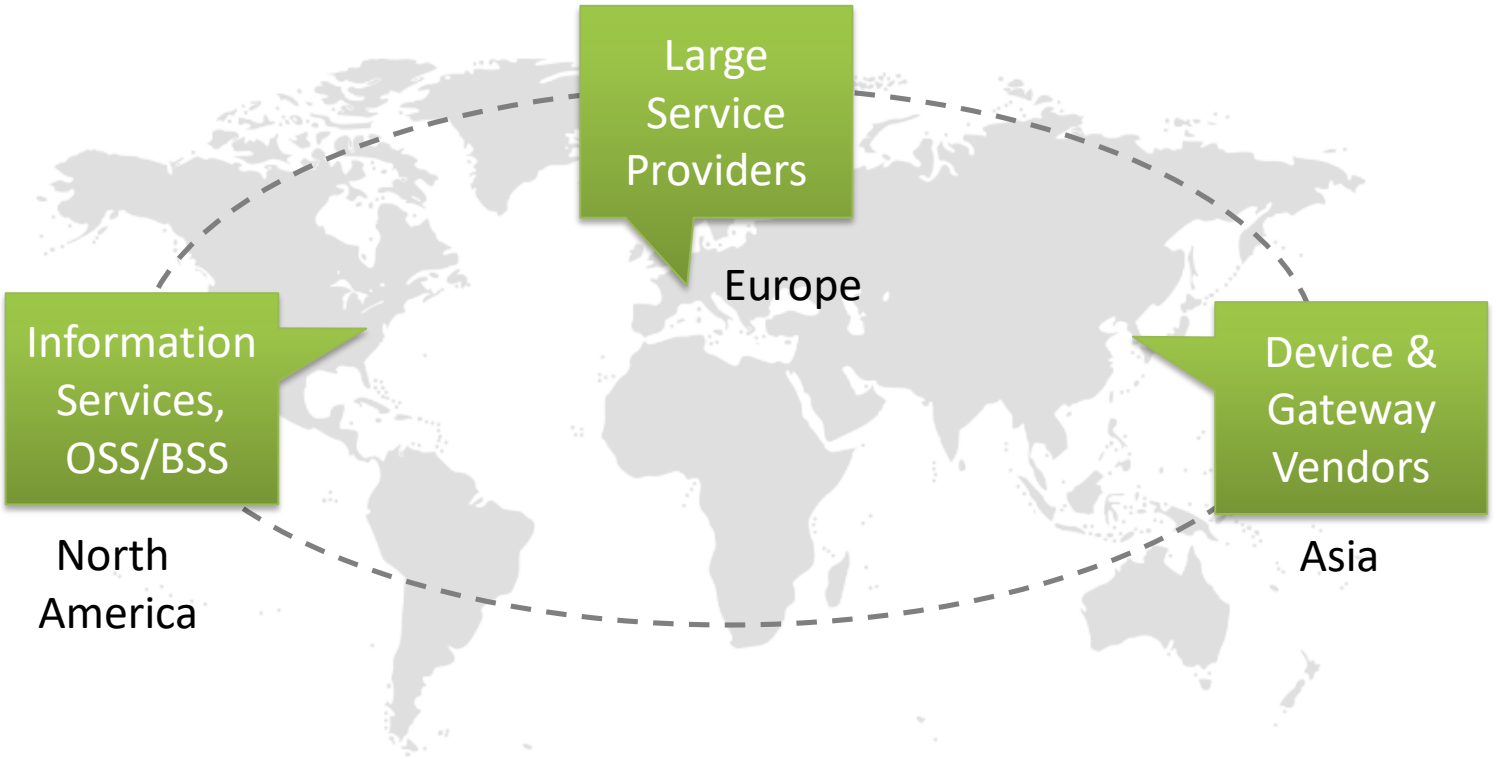
Product and Service positioning

- Application development platform for IoT to quickly connect devices and build secure applications.
- Integration with advanced analytics and connectivity solutions.
- A focus on Standards, Open API and Open Source.



Partnerships

- We are aiming to have solid partnerships worldwide and win-win engagements that make mutual business sense, while remaining focused on our vision.
- Our goal is to work in regional and strategic partnerships with industry leaders who share a similar vision and believe in the value of IoT.



Upcoming Events

- Sensinov Keynote and demonstration at IoT Korea Week 2016

  10-14 Oct 2016 at Seoul, Korea

- Sensinov & IBM joint demonstration at oneM2M Showcase Event. “oneM2M Watson IoT and Smart Appliances”

  15-17 Nov 2016 at Nice, France

- Sensinov participation to the 3rd oneM2M Interop Event.

  29 Nov - 02 Dec 2016 at Kobe, Japan

Thank you for your Attention

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www.sensinov.com